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(12) **United States Patent**
Moore et al.

(10) **Patent No.: US 12,157,543 B2**
(45) **Date of Patent: *Dec. 3, 2024**

(54) **ADJUSTABLE WATER FLOW DEFLECTION DEVICE FOR A WATERCRAFT AND METHODS OF USE**

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(73) Assignee: **Swell Ventures LLC**, White Bear Lake, MN (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 619 days.

This patent is subject to a terminal disclaimer.

(21) Appl. No.: **17/412,639**

(22) Filed: **Aug. 26, 2021**

(65) **Prior Publication Data**

US 2022/0048599 A1 Feb. 17, 2022

Related U.S. Application Data

(63) Continuation of application No. 16/818,776, filed on Mar. 13, 2020, now Pat. No. 11,214,338.

(51) **Int. Cl.**
B63B 34/75 (2020.01)
F15D 1/00 (2006.01)

(52) **U.S. Cl.**
CPC ***B63B 34/75*** (2020.02); ***F15D 1/005*** (2013.01)

(58) **Field of Classification Search**
CPC B63B 34/75; F15D 1/005
See application file for complete search history.

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(74) *Attorney, Agent, or Firm* — DeWitt LLP

(57) **ABSTRACT**

A water flow deflection device to enhance a watercraft's wake. An elongated base with two ends is aligned along the side of the watercraft. The base has a deflector interface with concentrically arranged teeth. A deflector assembly is operably attached to the base between the two ends, with a face that deflects water. The deflector's leading end is closer to the watercraft than the trailing end. The deflector assembly has a base interface with concentrically arranged teeth. Two or more suction cup assemblies attach to the elongated base to provide removable attachment, with one attached between a first end and the deflector interface and another attached between a second end and the deflector interface. The concentrically arranged teeth of the deflector interface and the base interface operably interlock, allowing rotational adjustment of the deflector relative to the base.

29 Claims, 15 Drawing Sheets

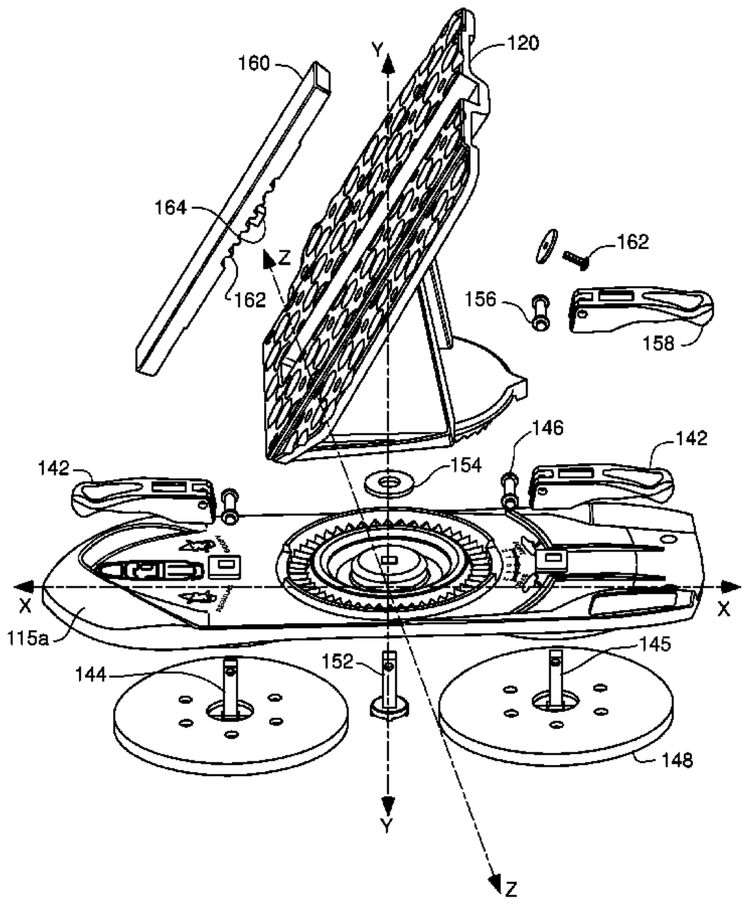

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FIG. 1

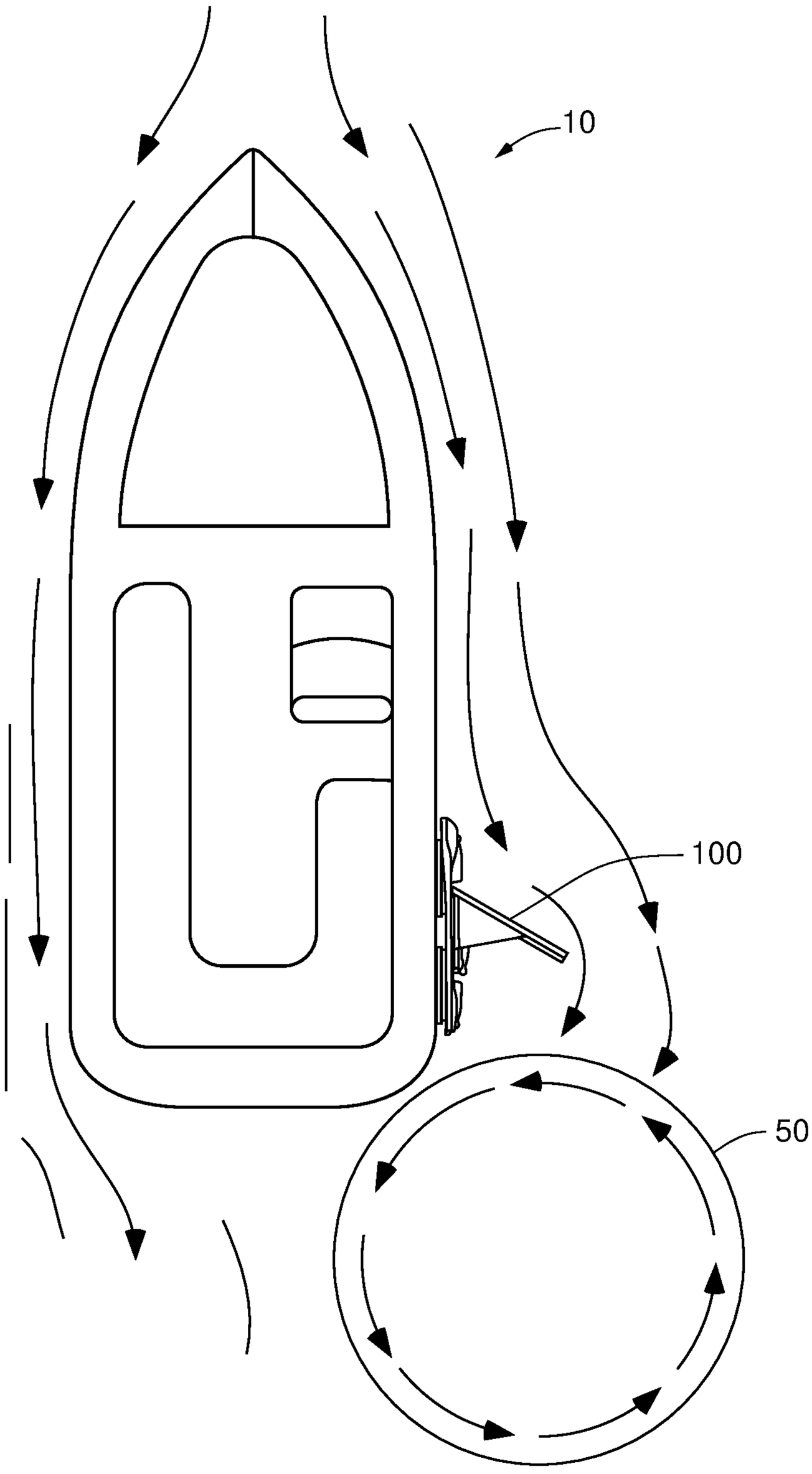


FIG. 2A

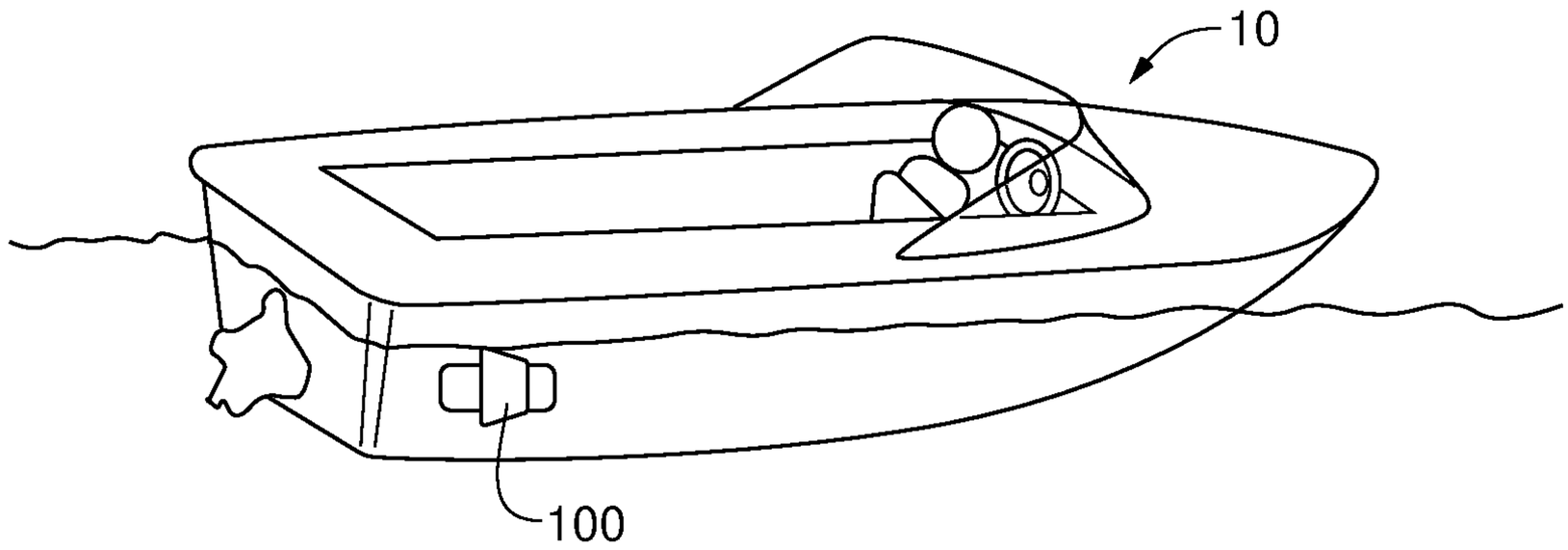


FIG. 2B

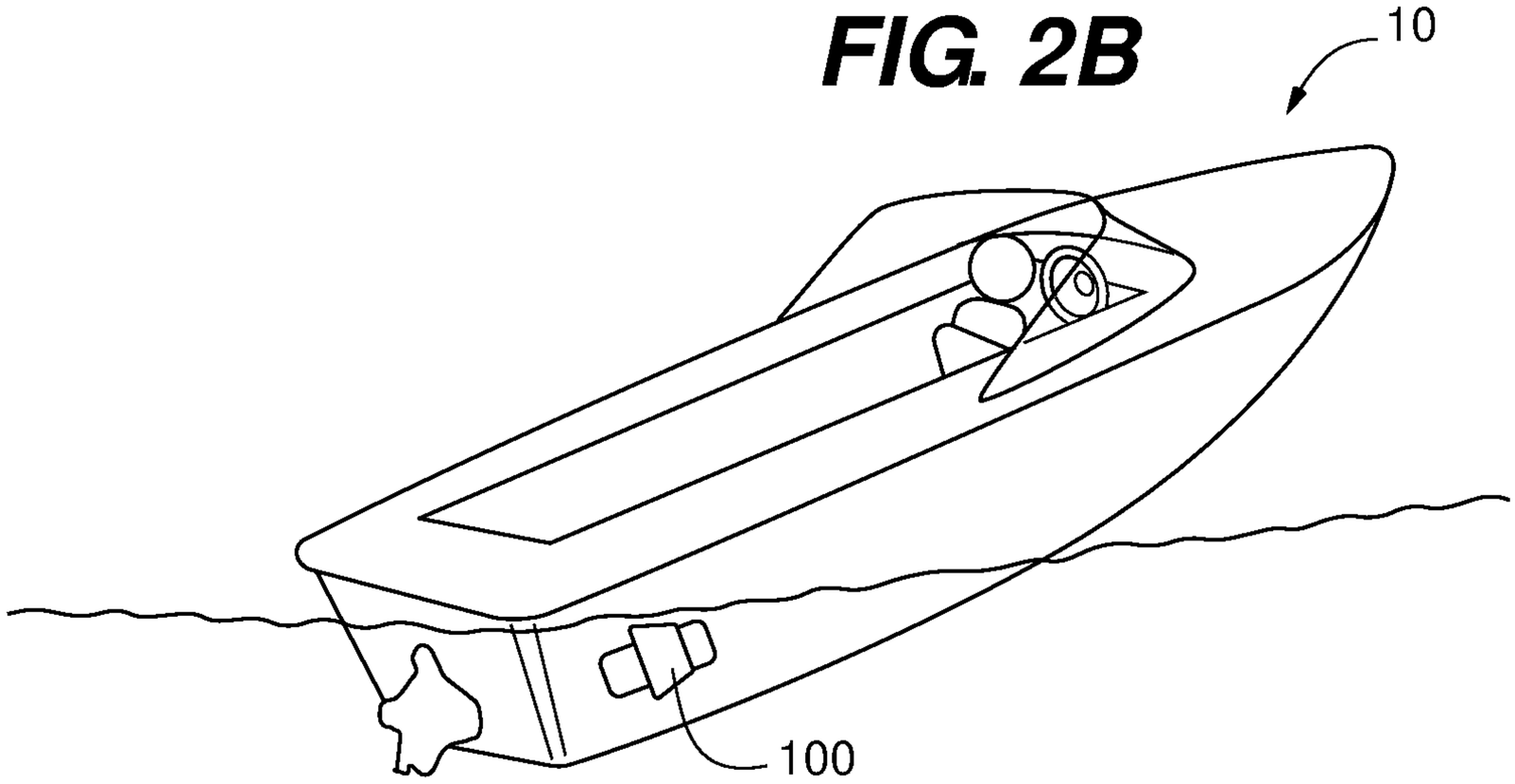


FIG. 2C

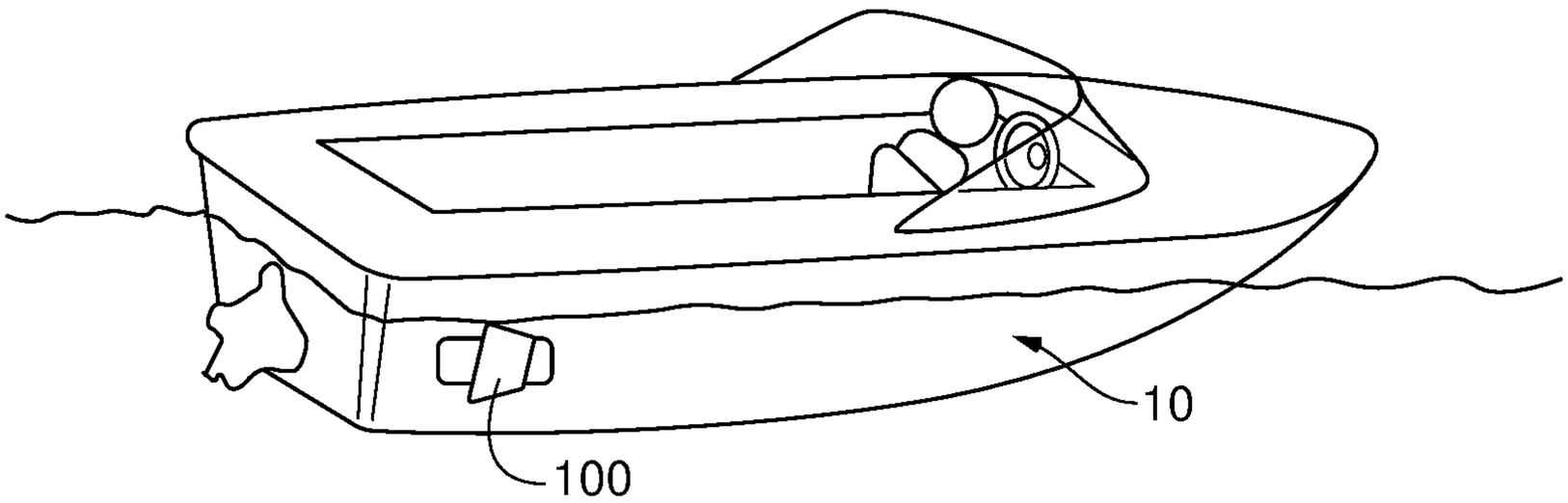


FIG. 2D

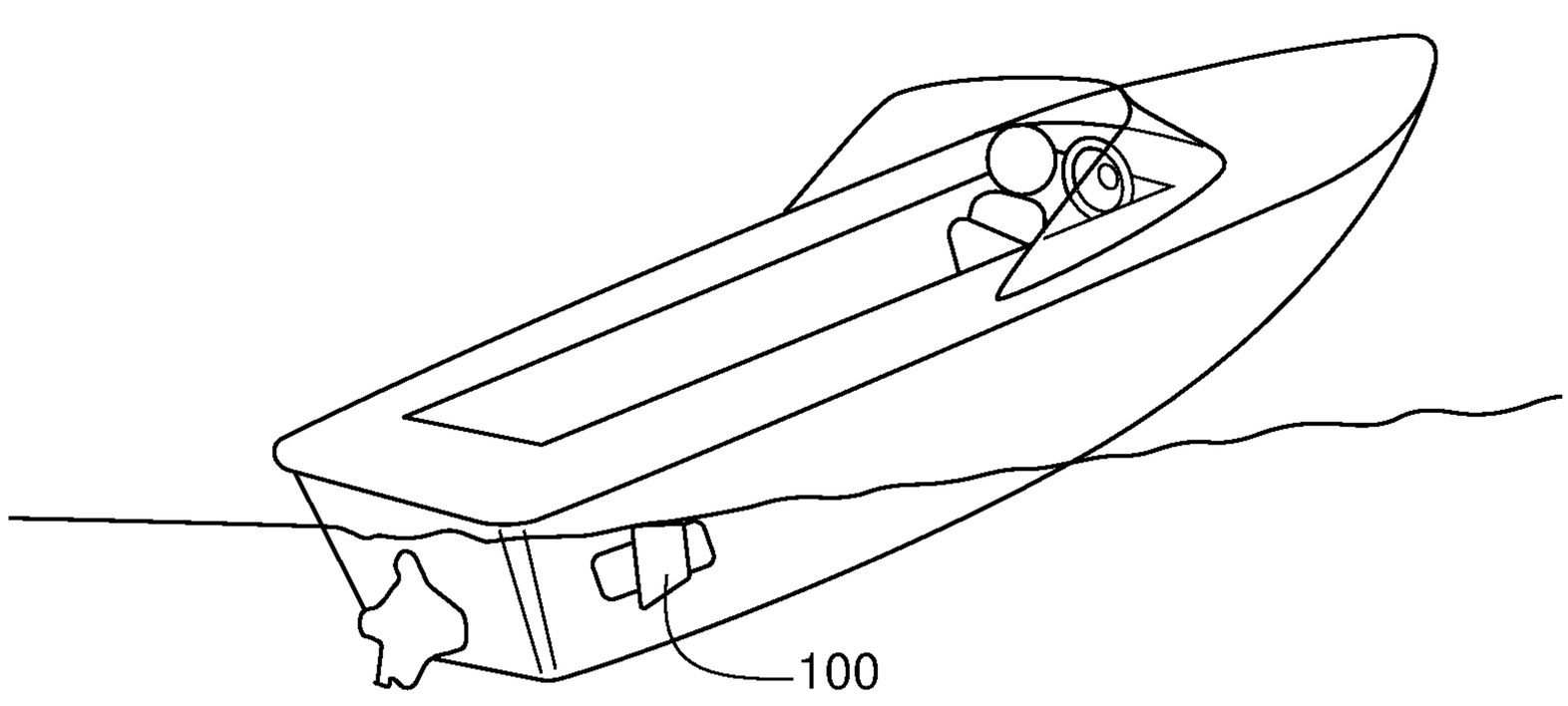


FIG. 3A

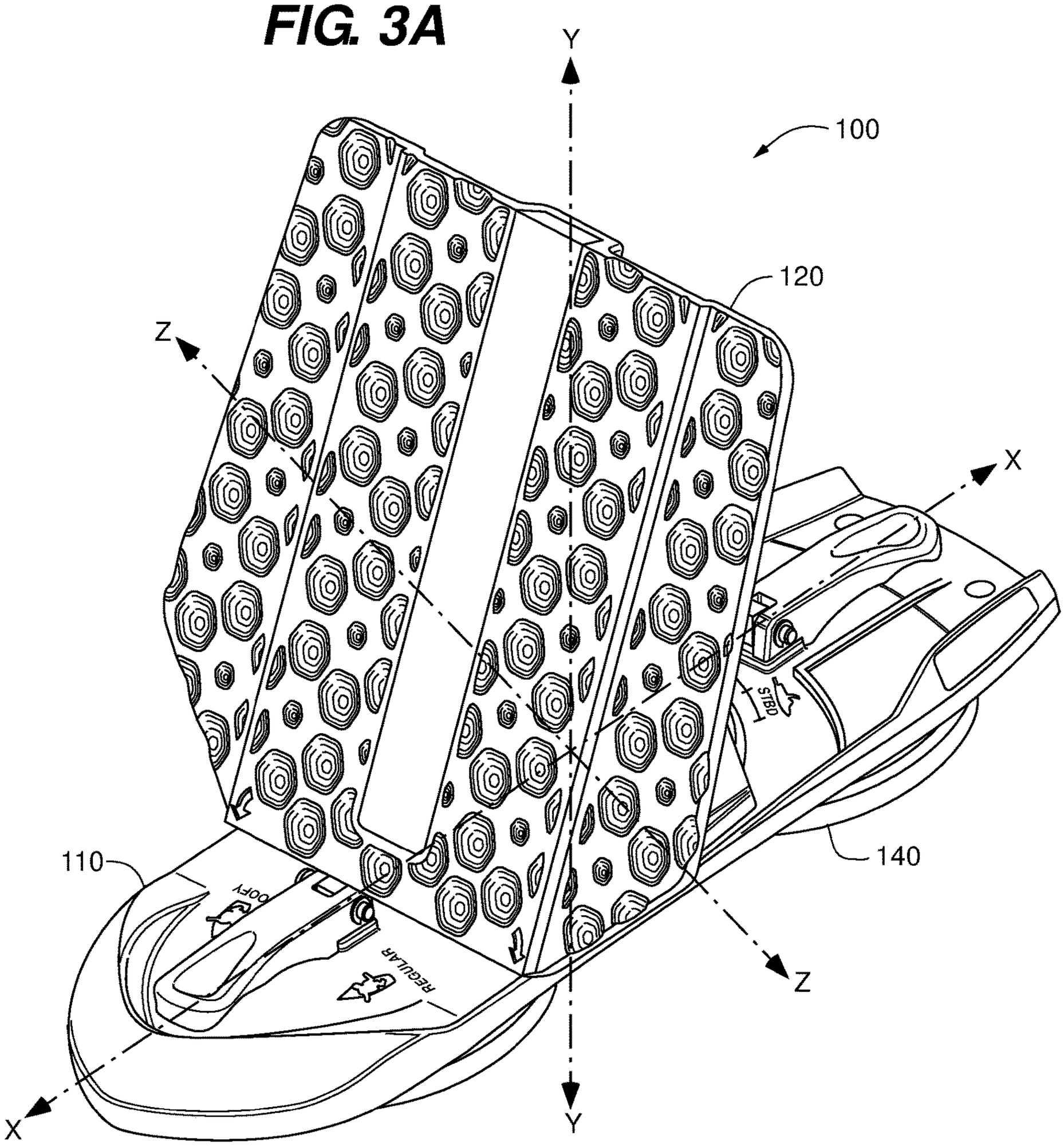


FIG. 3B

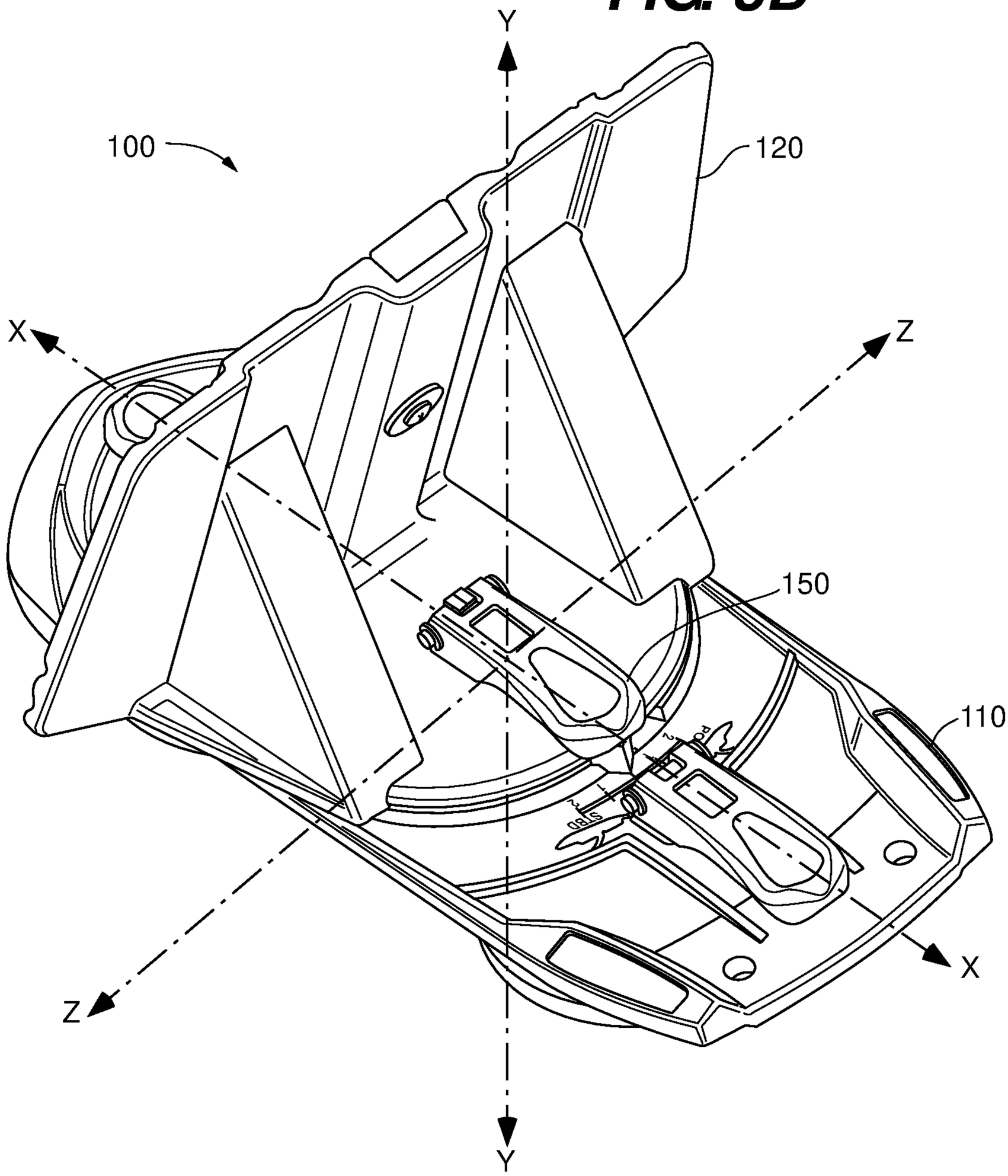
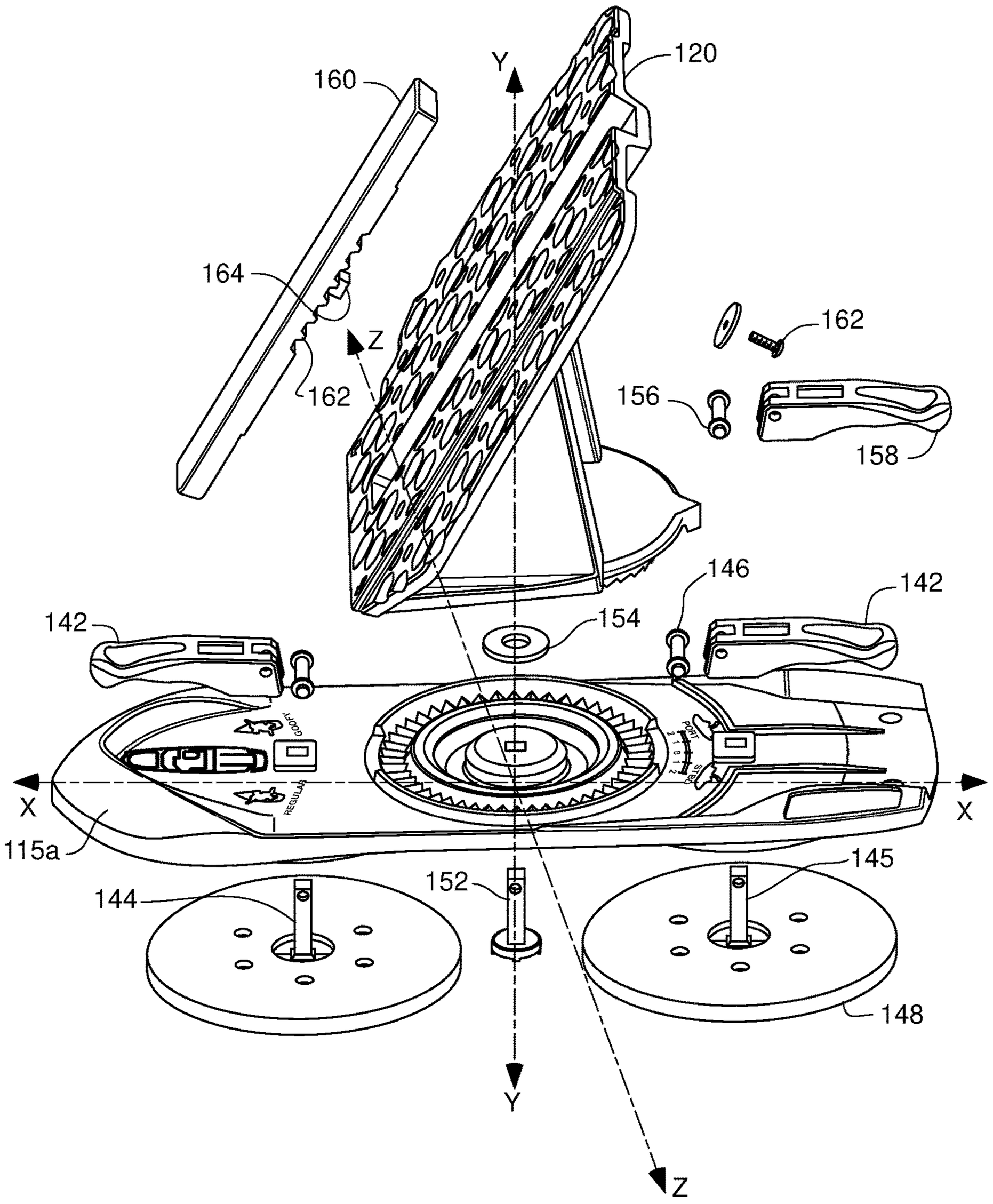


FIG. 4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Y
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164
162
Z
162
156
158
146
142
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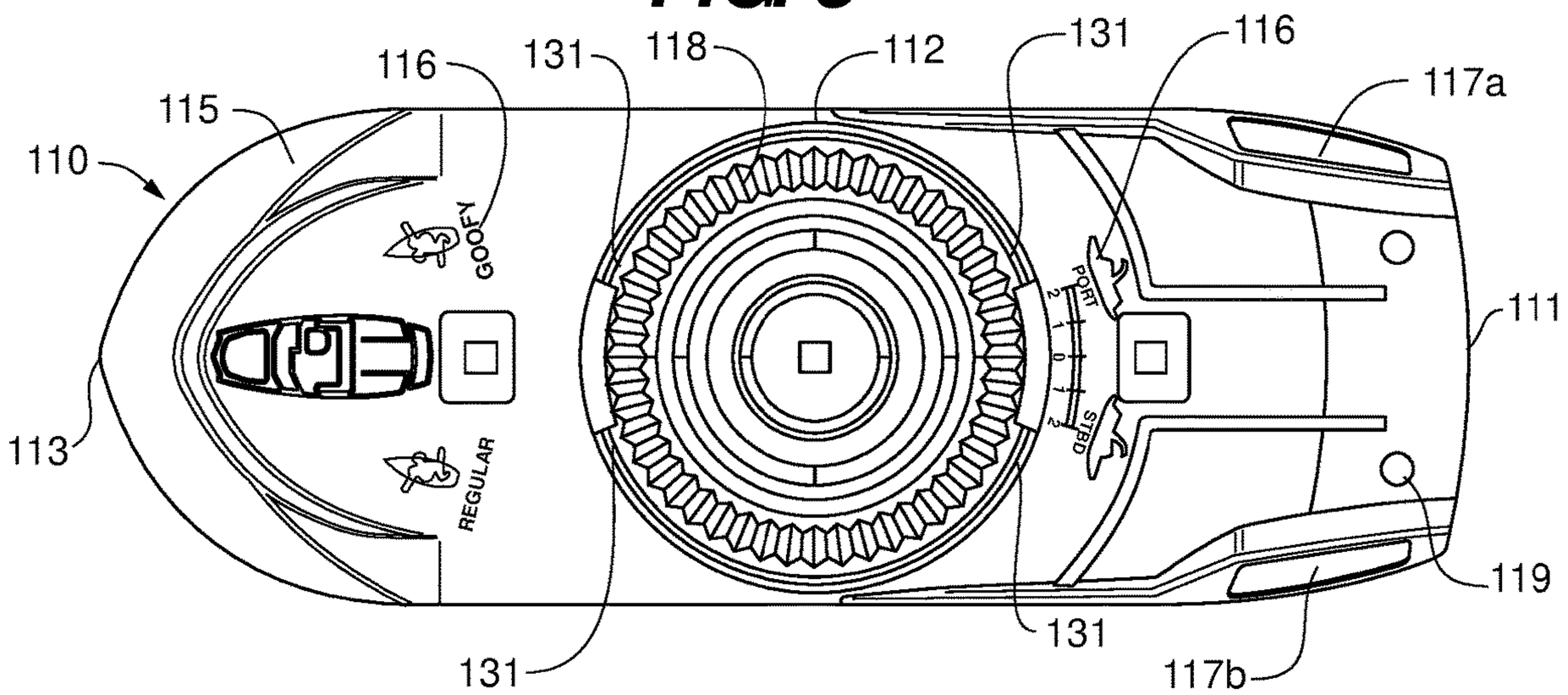
154
GOOFY
REGULAR
PORT
STBD
X
X
115a
145
152
144
148
Y
Z

FIG. 5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REGULAR
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131
117b

FIG. 6A

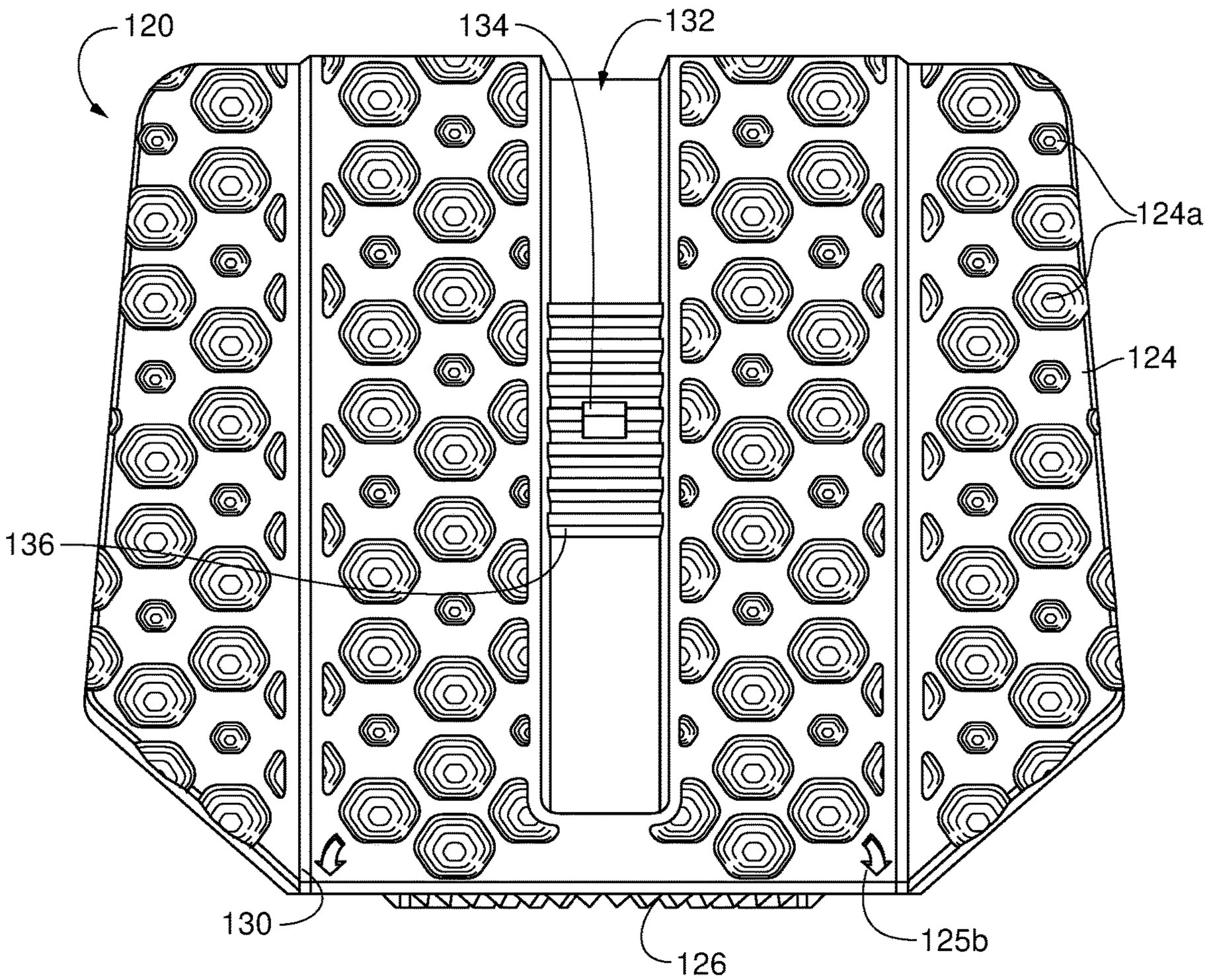
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FIG. 6B

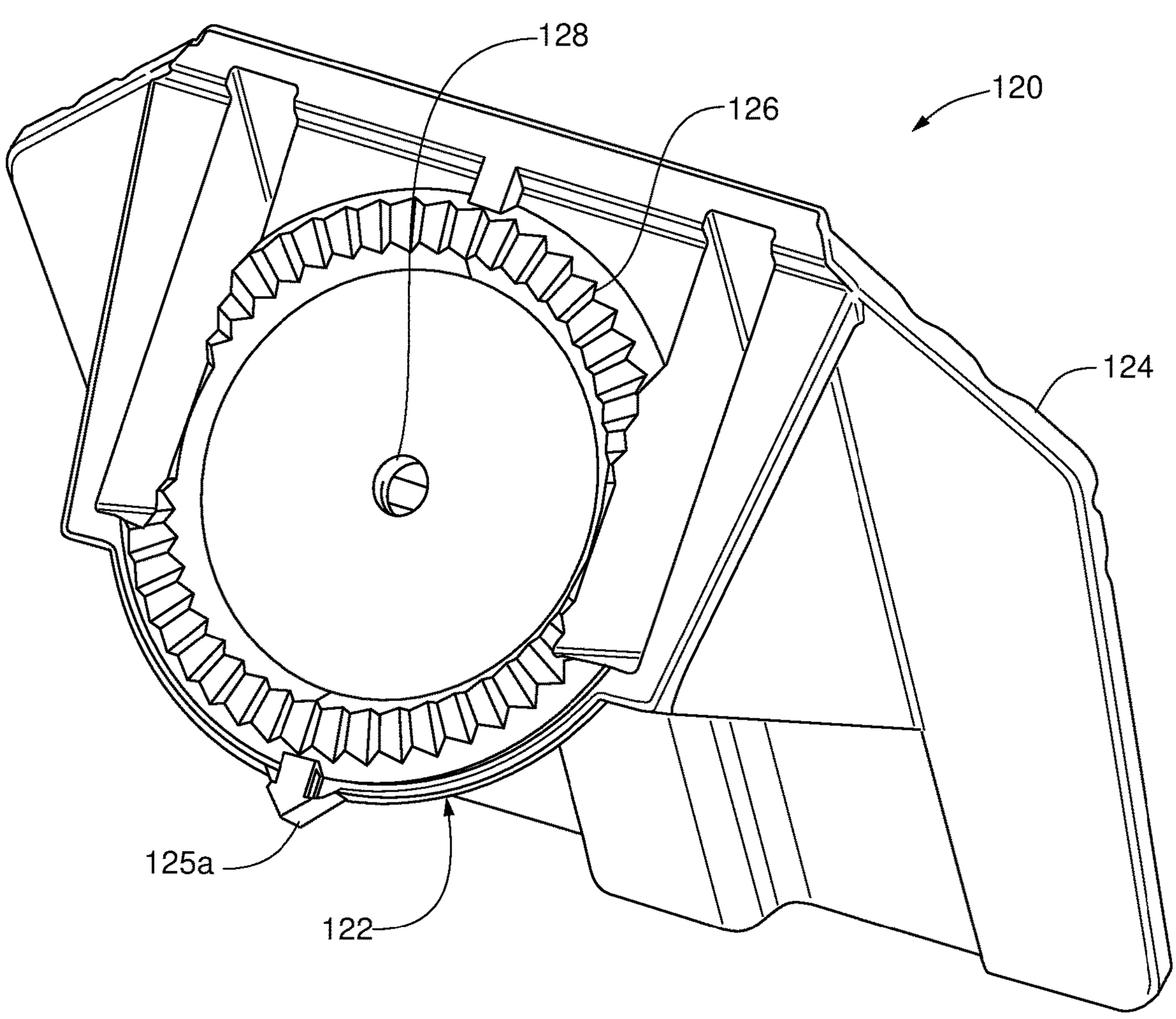


FIG. 7

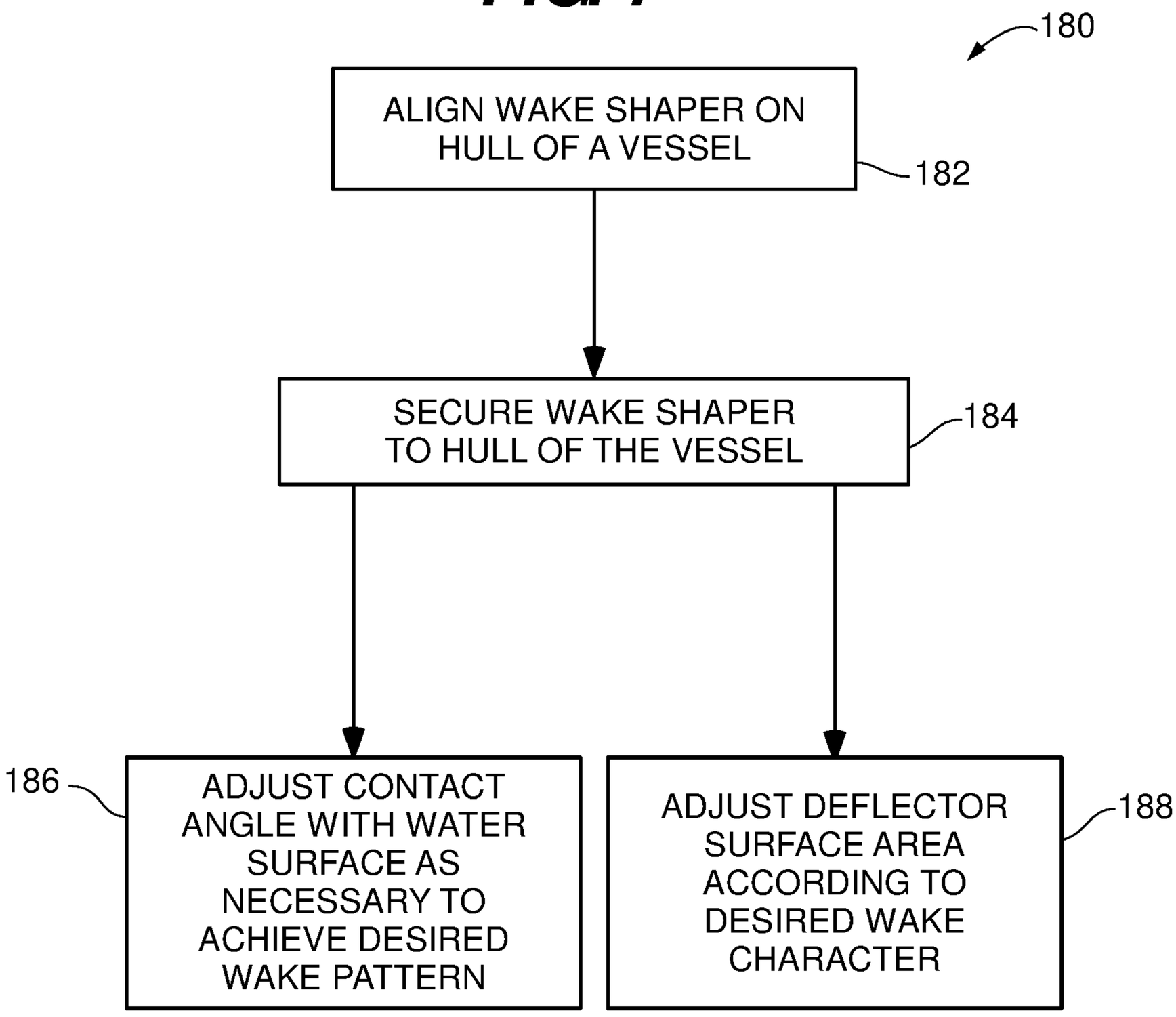

180
ALIGN WAKE SHAPER ON HULL OF A VESSEL
182
SECURE WAKE SHAPER TO HULL OF THE VESSEL
184
186
ADJUST CONTACT ANGLE WITH WATER SURFACE AS NECESSARY TO ACHIEVE DESIRED WAKE PATTERN
ADJUST DEFLECTOR SURFACE AREA ACCORDING TO DESIRED WAKE CHARACTER
188

FIG. 8A

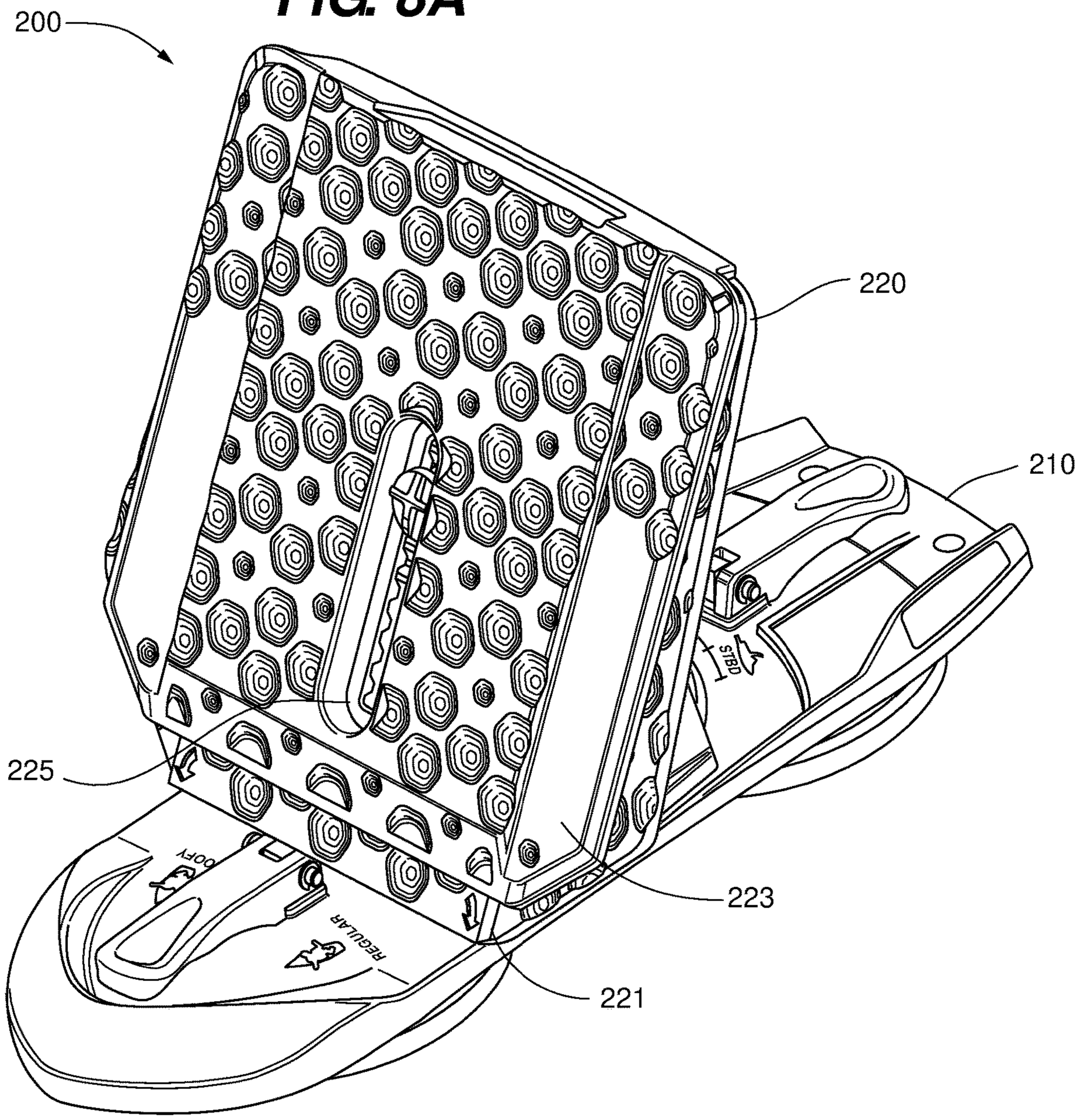


FIG. 8B

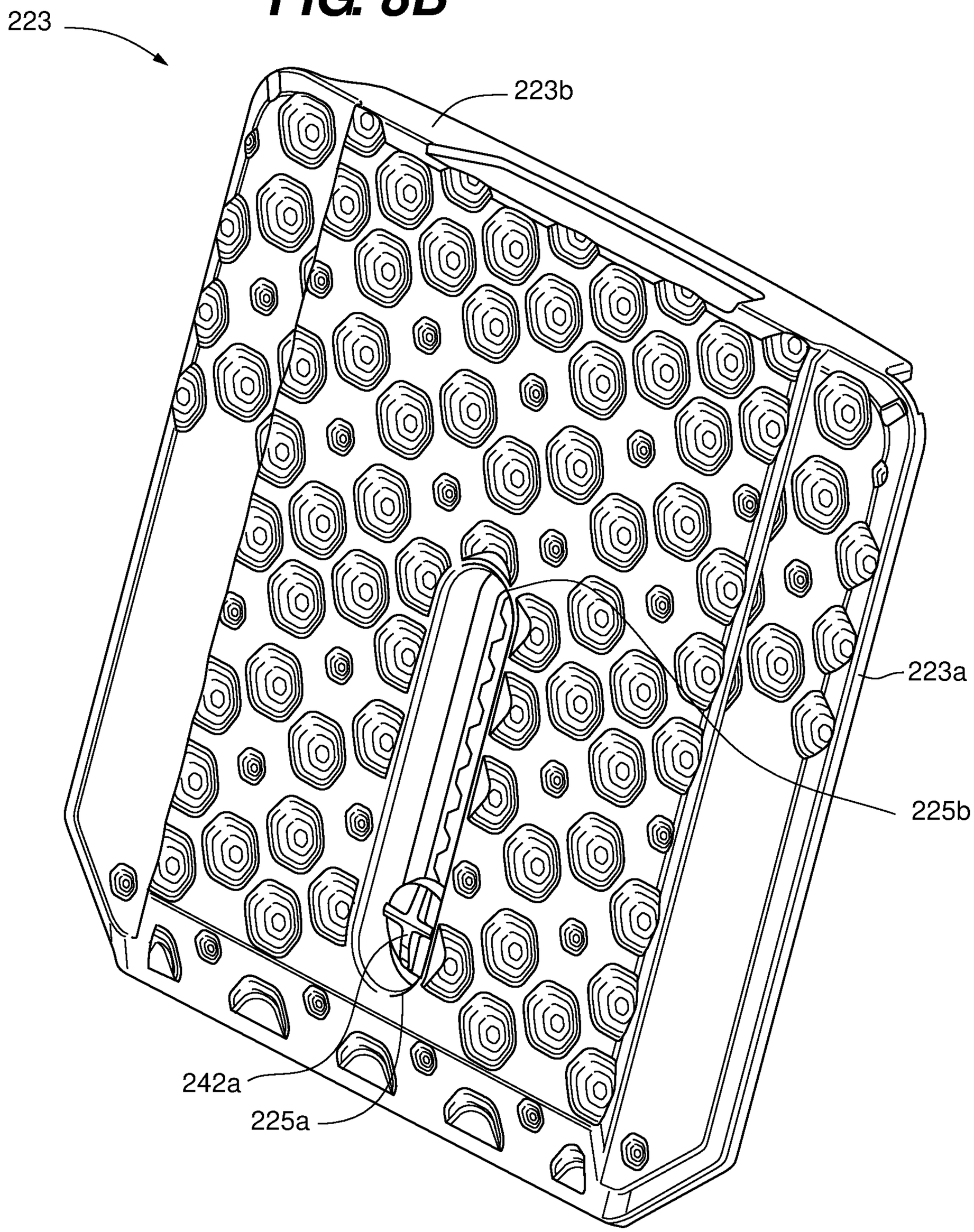


FIG. 8C

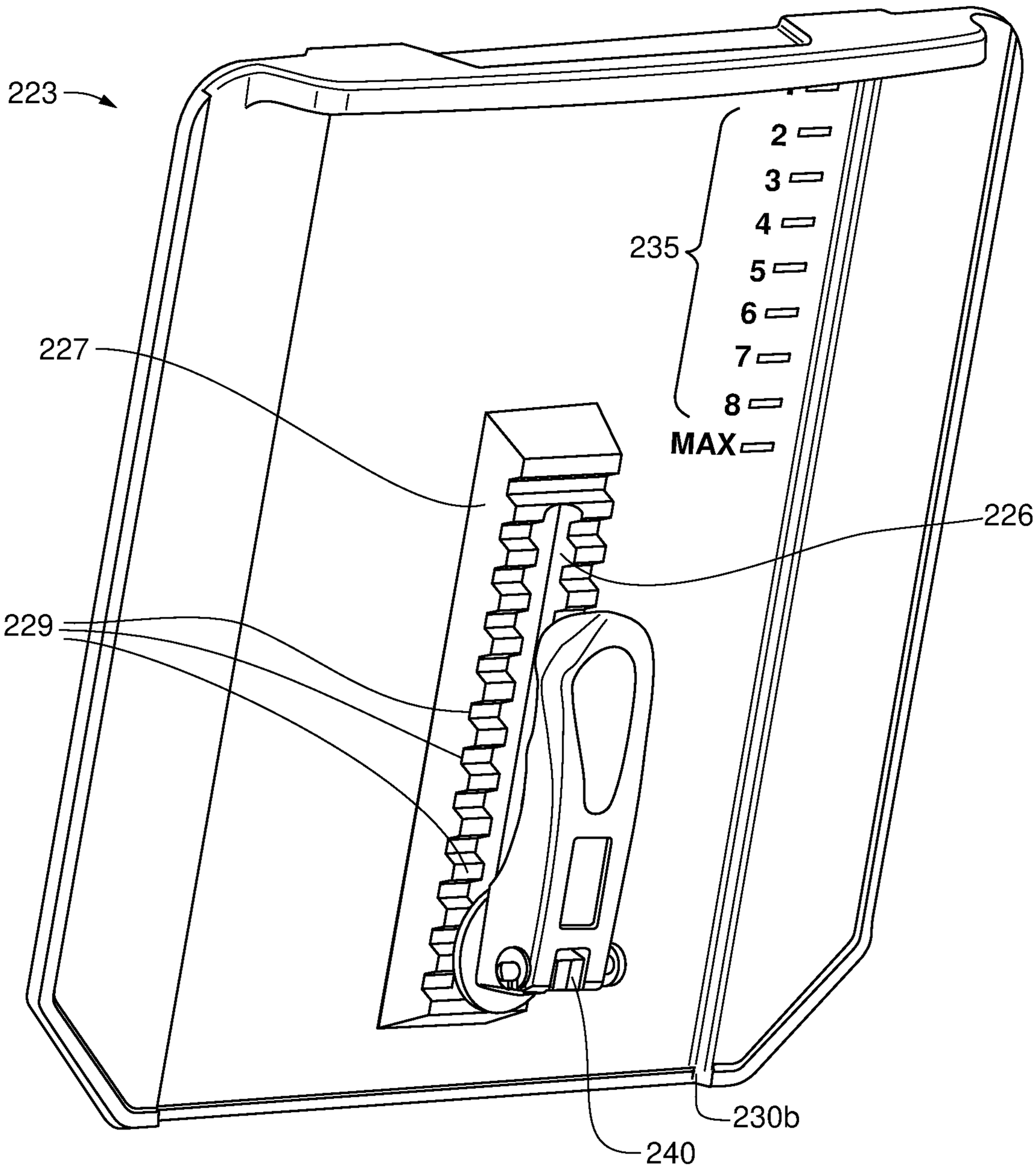


FIG. 8D

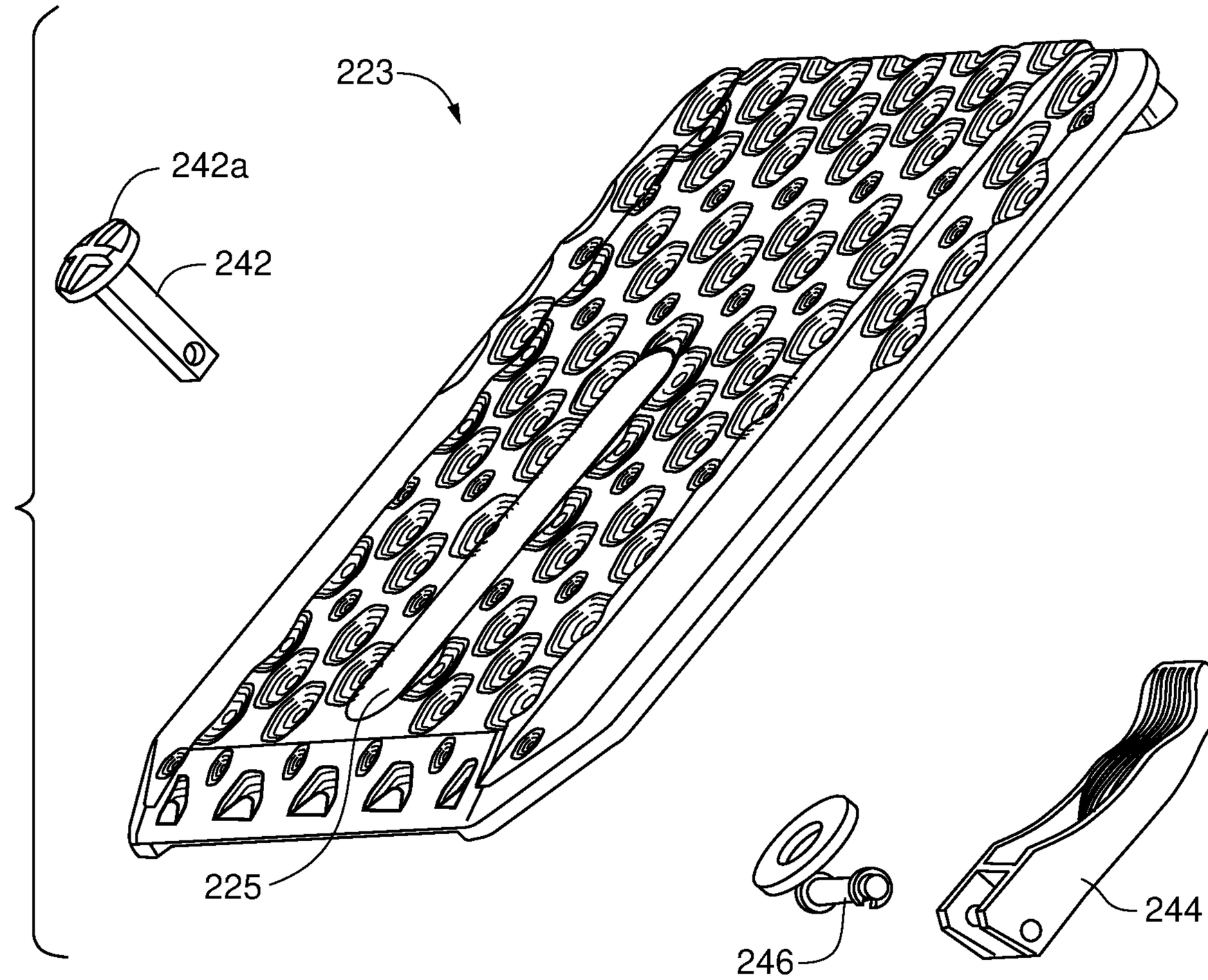


FIG. 9A

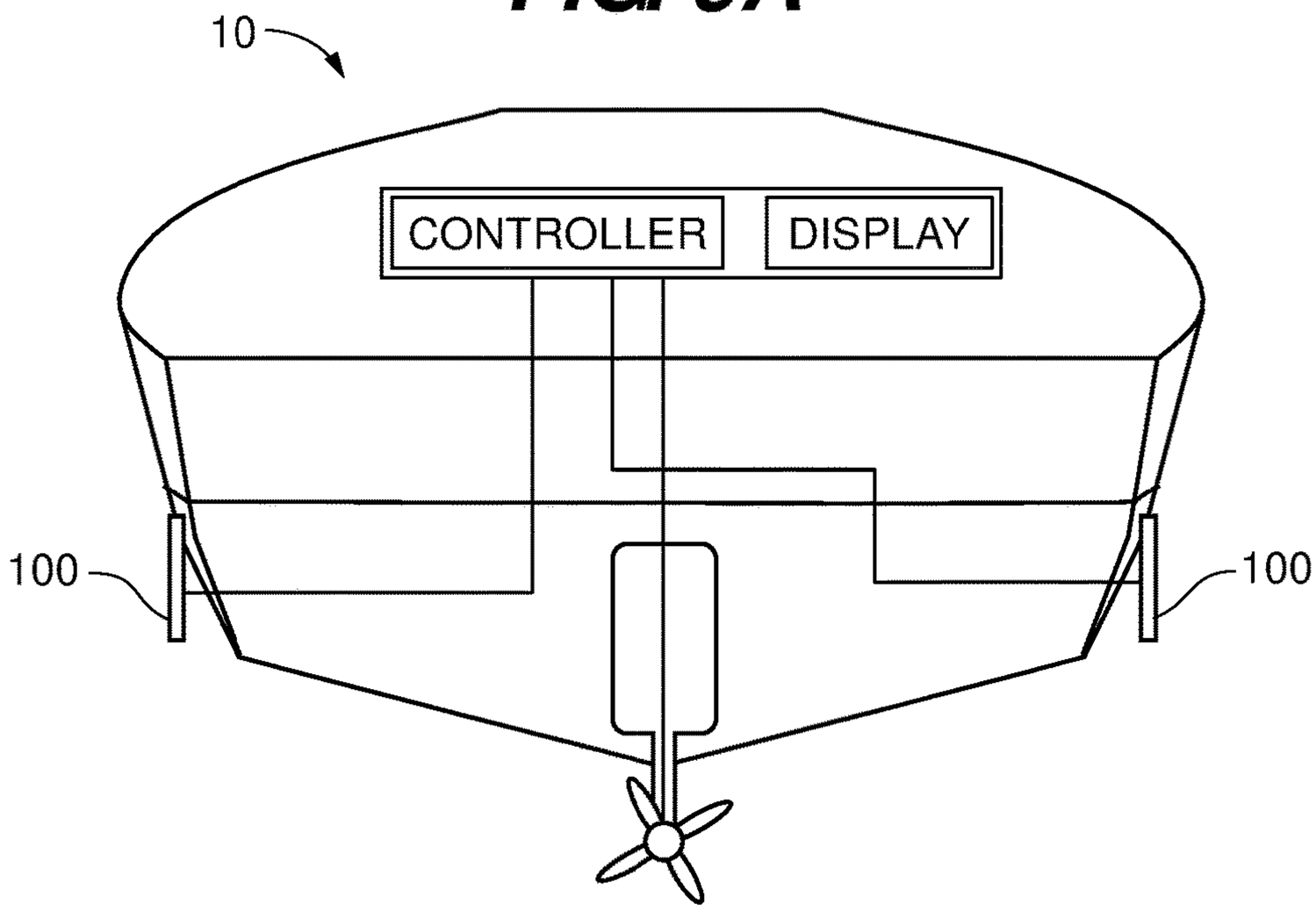


FIG. 9B

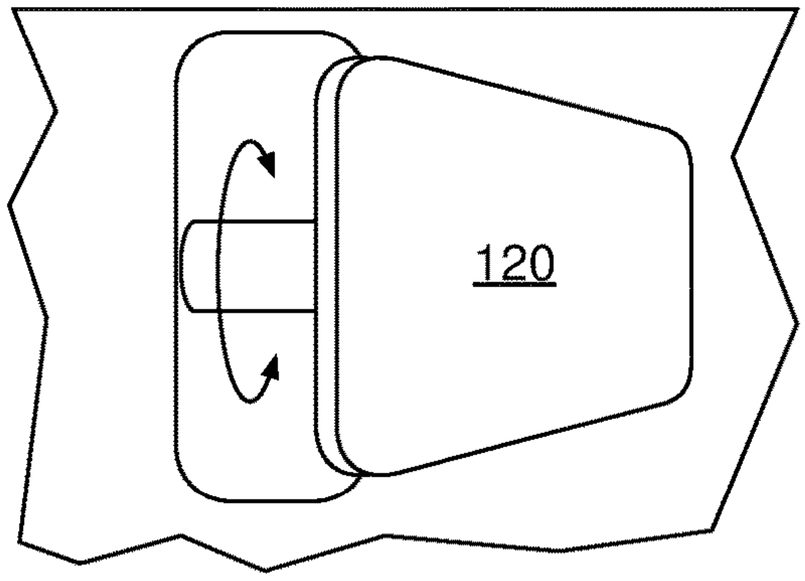


FIG. 9C

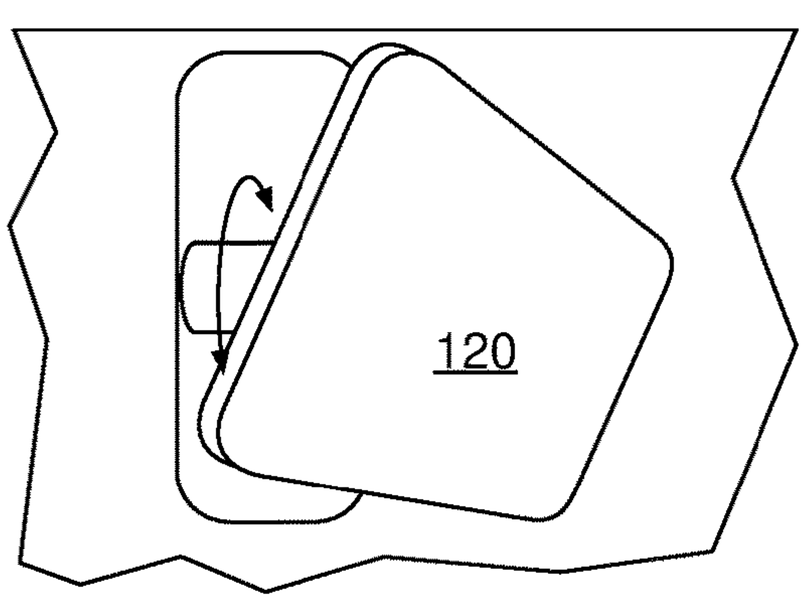


FIG. 10A

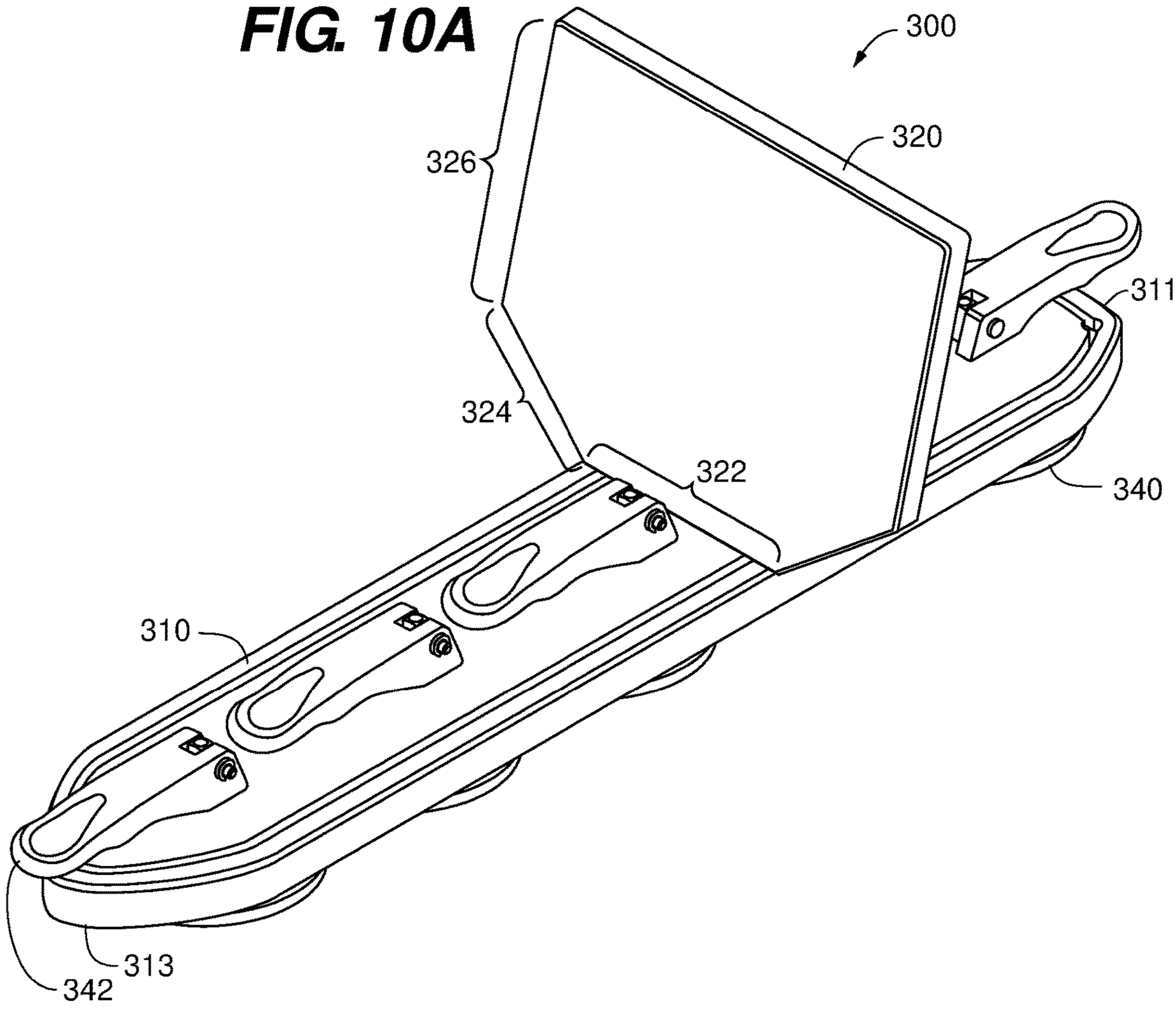
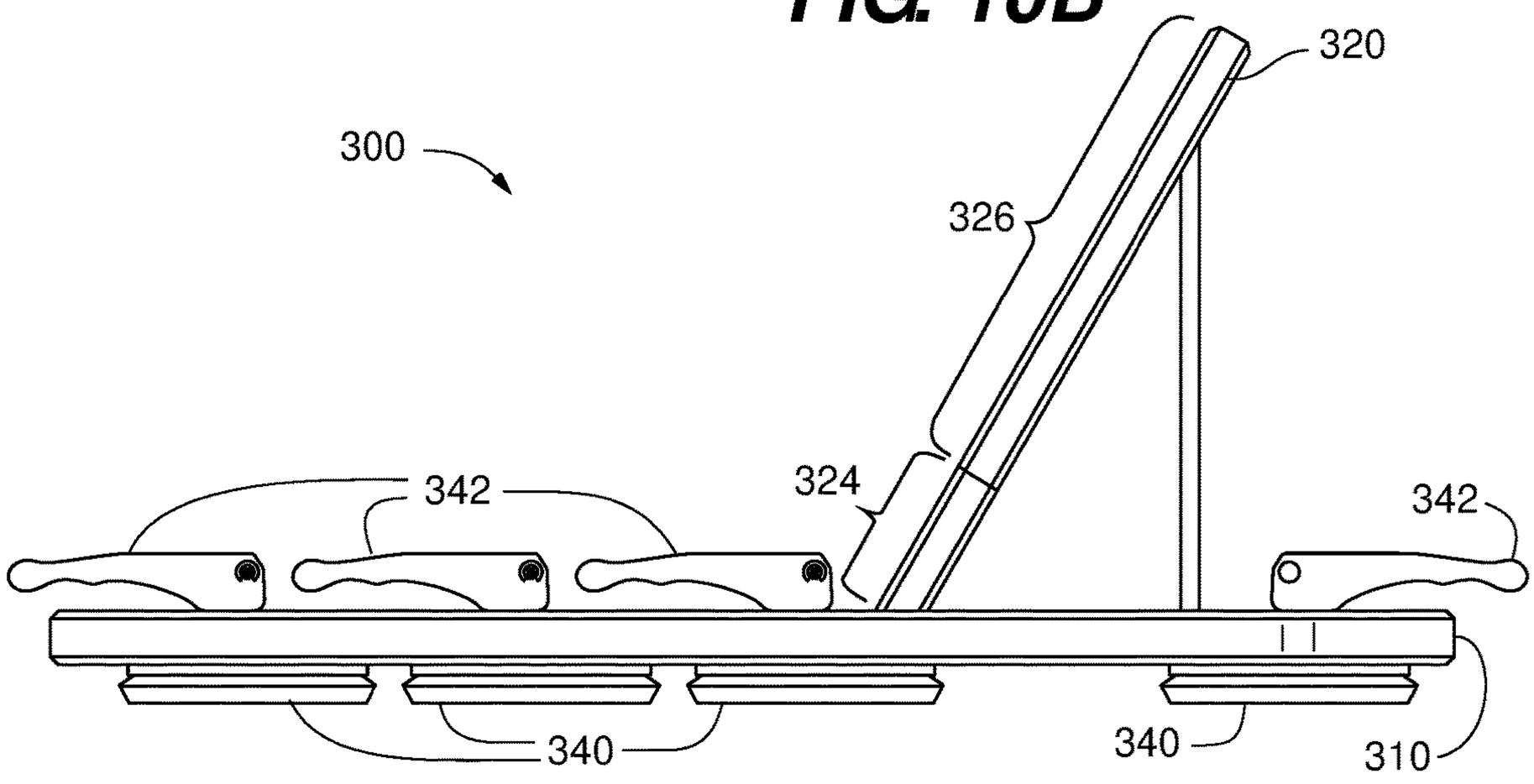


FIG. 10B



ADJUSTABLE WATER FLOW DEFLECTION DEVICE FOR A WATERCRAFT AND METHODS OF USE

RELATED APPLICATION

This application is a continuation of application Ser. No. 16/818,776, filed Mar. 13, 2020, which is hereby fully incorporated herein by reference.

TECHNICAL FIELD

The present invention relates generally to watercraft accessories, in particular wake shaping enhancement of a watercraft by a water flow deflection device, and even more in particular an adjustable water flow deflection device that can enhance the formation of a desirable wake behind a watercraft.

BACKGROUND

Wake surfing, a water sport in which a rider performs surfing maneuvers on a surfboard in the wake of a boat without being directly pulled by the boat, has risen dramatically in popularity over the last several decades. Wake surfing largely emerged as an offshoot of wakeboarding, and likewise made use of conventional water ski boats, despite the relatively flat wake which is ideal for skiing being ill-suited to surfing. In response, highly specialized sports boat designs have since emerged with features including inboard propellers and elaborate ballast systems to maximize the boat's wake for surfing.

These specialized surfboats may incorporate a deflector, often positioned near the stern of the vessel, to shape the vessels wake. However, such specialized boats have their deflectors limited to a secured position (parallel to the hull) and a deployed position (perpendicular to the hull). Adjustment of the deflector's position in the water is accomplished by ballast adjustment of the entire vessel.

Further, surfboats are rarely suitable for other uses and are cost prohibitive for a large portion of the consumer market. However, conventional water ski boats are designed to minimize waves, such that the generation of a wake behind a conventional water ski boat is not ideal without specialized equipment.

Thus, there is a need for adapting a variety watercrafts for wake surfing. There is also a need for aftermarket adaptability of a variety of watercrafts for wake surfing. There is a further need for adjustability in aftermarket devices to provide maximum wake with minimal modifications of a watercraft. There is a further need to maximize the hydrodynamics of such aftermarket devices.

SUMMARY

Disclosed herein are embodiments of a water flow deflection device for enhancing wake formation behind a watercraft. In some aspects, the water flow deflection device is configured to be attachable to a side of a watercraft, in some preferable aspects the hull of a watercraft. In some aspects, the water flow deflection device is an integral accessory on one or more sides of the hull of a watercraft.

In some aspects, the water flow deflection device has an adjustable deflector, such that the deflector is capable of being adjusted in a vertical manner with respect to oncoming water to enhance the water flow deflection as the watercraft moves through the water and thereby enhancement of wake formation behind the watercraft. The deflector may be adjusted automatically or manually to provide desired wake shaping behind a watercraft. In some aspects, such as in attachable and removeable aftermarket devices, the deflector is manually adjusted to a desired deflector position, such that the deflector obtains a desirable vertical position with respect to the oncoming water upon the watercraft reaching the desired speed moving through the water. In some other preferred aspects, such as in an integral accessory on one or both sides of the hull of the watercraft, the deflector is configured to automatically adjust to a desirable vertical position with respect to the oncoming water while the watercraft is moving through the water.

In some aspects, the desirable vertical position of the deflector is such that the face of the deflector is configured to be approximately perpendicular to the flow of the oncoming water during normal operational use. In some aspects, the desirable vertical position of the deflector is such that the face of the deflector is configured to be approximately perpendicular to the water surface during normal operational use. In some aspects, the deflection face of the water deflection device is rotatable in a vertical direction relative to the hull of the watercraft, allowing for rapid and convenient adjustment of the contact angle between the deflector face and the oncoming water in response to changes in the crafts ballast, the weather or water conditions, the surfer's preference, or other conditions.

In some aspects, a water flow deflection device is configured to be attached to a side of a watercraft for the enhancement of a watercraft wake, and comprises an elongated base, a deflector assembly, and two or more suction cup assemblies. The elongated base has a first end and a second end and is configured to be aligned along the side of the watercraft when the water flow deflection device is attached to the watercraft. The elongated base has a deflector interface having a first plurality of concentrically arranged teeth. The deflector assembly is operably attached to the base between the first and second ends of the elongated base and comprises a deflector face spanning between a leading end and an opposing end. The leading end extends outwardly from the elongated base at an acute angle. The deflector face has a surface area configured to deflect water, with the leading end being in closer proximity to the watercraft than the trailing end when the water flow device is attached to the watercraft. The deflector assembly has a base interface having a second plurality of concentrically arranged teeth. The two or more suction cup assemblies attach to the elongated base, with a first suction cup is attached to the elongated base between the first end and the deflector interface and a second suction cup is attached to the elongated base between the second end and the deflector interface. Together the first and second suction cups are configured to provide removable attachment of the elongated base to the watercraft. The first plurality of concentrically arranged teeth of the deflector interface and the second plurality of concentrically arranged teeth of the base interface are configured to operably interlock with each other, and the first and second plurality of concentrically arranged teeth are configured to allow a rotational adjustment of the deflector relative to the elongated base.

The rotational adjustment of the deflector relative to the elongated base may be between about 0° to about 30° in either direction. The rotational adjustment of the deflector relative to the elongated base may provide a total range of rotational motion of about 60°. The rotational adjustment of the deflector relative to the elongated base may be between about 0° to about 22.50° in either direction. The rotational

adjustment of the deflector relative to the elongated base may provide a total range of rotational motion of about 45°.

The first and second plurality of concentrically arranged teeth may be between about 40 teeth and about 120 teeth, such that the rotational adjustment of the deflector per tooth is between about 3° and about 9°. The deflector assembly may have one or more rotational alignment guidance indicia proximately located the base interface. The elongated base may have one or more rotational alignment guidance indicia proximately located the deflector interface.

The deflector face may have a textured surface comprising a plurality of geometrically shaped concave indentations.

The deflector assembly may have a base deflector operably attached to an extendible deflector that is capable of slidably adjust the surface area of the deflector face of the deflector assembly. The extendible deflector may overlay at least a portion of the base deflector and is capable of being slidably adjusted relative to the base deflector between a retracted position, fully extended position and one or more intermediate extended positions.

In some aspects, the invention is directed to water flow deflection device configured to be attached to a side of a watercraft for the enhancement of a watercraft wake. The water flow deflection device comprises an elongated base, a deflector assembly, and two or more suction cup assemblies. The elongated base has a first end and a second end and is configured to be aligned along the side of the watercraft when the water flow deflection device is attached to the watercraft. The deflector assembly is operably attached to the base between the first and second ends and comprises a deflector face spanning between a leading end and an opposing end. The leading end extends outwardly from the elongated base at an acute angle. The deflector face has a surface area configured to deflect water, with the leading end being in closer proximity to the watercraft than the trailing end when the water flow device is attached to the watercraft. The deflector face has a textured surface comprising a plurality of geometrically shaped concave indentations. The two or more suction cup assemblies are attached to the elongated base, with a first suction cup being attached to the elongated base between the first end and the deflector assembly and a second suction cup being attached to the elongated base between the second end and the deflector assembly. Together the first and second suction cups are configured to provide removable attachment of the elongated base to the watercraft.

The plurality of geometrically shaped concave indentations may have a hexagonal shape. The plurality of geometrically shaped concave indentations may each be approximately the same size and shape.

The elongated base may have a deflector interface with a first plurality of concentrically arranged teeth configured to operably interlock with a second plurality of concentrically arranged teeth proximately located on a base interface of the deflector assembly. The first and second plurality of concentrically arranged teeth may be configured to allow a rotational adjustment of the deflector relative to the elongated base. The rotational adjustment of the deflector relative to the elongated base may be between about 0° to about 30° in either direction providing a total range of rotational motion of about 60°.

The deflector assembly may comprise a base deflector operably attached to an extendible deflector, wherein the extendible deflector is capable of being slidably extended relative to the base deflector to adjust the surface area of the deflector face of the deflector assembly. The extendible deflector may overlay at least a portion of the base deflector and may be capable of being slidably adjusted relative to the base deflector between a retracted position, with a fully extended position and one or more intermediate extended positions. Both the base deflector and the extendible deflector may have the textured surface comprising the plurality of geometrically shaped concave indentations.

The above summary is not intended to describe each illustrated embodiment or every implementation of the subject matter hereof. The figures and the detailed description that follow more particularly exemplify various embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

Subject matter hereof may be more completely understood in consideration of the following detailed description of various embodiments in connection with the accompanying figures, in which:

FIG. **1** is a top perspective view of a water flow deflection device attached to the side of a watercraft, according to certain embodiments of the present invention.

FIG. **2**A is a side perspective view of the water flow deflection device of FIG. **1** attached to the side of the watercraft with the deflector set at a normal position and the watercraft at a stationary position not moving through the water, according to certain embodiments of the present invention.

FIG. **2**B is a side perspective view of the water flow deflection device of FIG. **1** attached to the side of the watercraft with the deflector set at a normal position and the watercraft moving through the water at a normal water surfing speed, according to certain embodiments of the present invention.

FIG. **2**C is a side perspective view of the water flow deflection device of FIG. **1** attached to the side of the watercraft with the deflector rotatably adjusted and the watercraft at a stationary position not moving through the water, according to certain embodiments of the present invention.

FIG. **2**D is a side perspective view of the water flow deflection device of FIG. **1** attached to the side of the watercraft with the deflector rotatably adjusted and the watercraft moving through the water at a normal water surfing speed, according to certain embodiments of the present invention.

FIG. **3**A is a top, front side perspective view of a water flow deflection device, according to certain embodiments of the present invention.

FIG. **3**B is top, rear side perspective view of the wave flow deflection device of FIG. **1**, according to certain embodiments of the present invention.

FIG. **4** is a side perspective exploded view of the water flow deflection device of FIG. **1**, according to certain embodiments of the present invention.

FIG. **5** is top view of a base plate for a water flow deflection device, according to certain embodiments of the present invention.

FIG. **6**A is a front plan view of a deflector of the water flow deflection device, according to certain embodiments of the present invention.

FIG. **6**B is a bottom perspective view of the deflector of FIG. **6**A, according to certain embodiments of the present invention.

FIG. **7** is a flowchart of method for using an adjustable water flow deflection device that is attachable and removeable from a watercraft, according to certain embodiments of the present disclosure.

FIG. **8**A is a front side perspective view of a deflector of the water flow deflection device, according to certain embodiments of the present invention.

FIG. **8**B is a front side perspective view of the deflector of FIG. **8**A, according to certain embodiments of the present invention.

FIG. **8**C is a rear side perspective view of the deflector of FIG. **8**A, according to certain embodiments of the present invention.

FIG. **8**D is an exploded view of the deflector of FIGS. **8**A-**8**C, according to certain embodiments of the present invention.

FIG. **9**A is a rear perspective view of water flow deflection devices integral with the hull on each side of a watercraft, according to certain embodiments of the present invention.

FIG. **9**B is a side perspective view of the water flow deflection device of FIG. **9**A on the starboard side of the watercraft in an unadjusted position, according to certain embodiments of the present invention.

FIG. **9**C is a side perspective view of the water flow deflection device of FIGS. **9**A-**9**B on the starboard side of the watercraft in a rotatably adjusted position, according to certain embodiments of the present invention.

FIG. **10**A is a front perspective view of a slim body water flow deflection device, according to certain embodiments of the present invention.

FIG. **10**B is a side perspective view of the water flow deflection device of FIG. **10**A, according to certain embodiments of the present invention.

While various embodiments are amenable to various modifications and alternative forms, specifics thereof have been shown by way of example in the drawings and will be described in detail. It should be understood, however, that the intention is not to limit the claimed inventions to the particular embodiments described. On the contrary, the intention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the subject matter as defined by the claims.

DETAILED DESCRIPTION

Described herein is a water flow deflection device for altering a watercraft's wake, such that the water flow deflection device is capable of enhancing the watercraft's wake to improve its surfable characteristics. By adjusting the angle of the deflector of the water flow deflection device to the oncoming water, different wake sizes and characteristics may be achieved. Surfers of different size and skill levels may desire wakes of different sizes and characteristics. By improving the ease of adjustability of a water flow deflection device, the present disclosure provides for wider applicability of the water flow deflection device to different skill levels of users and watercrafts. By enabling the deflector of the water flow deflection device to adjust in a vertical configuration with respect to the oncoming water, the user has greater control over the contact angle between the water flow deflection device and the oncoming water and proper positioning of the water flow deflection device for ideal wake conditions is more easily achieved. Also, by enabling the user to control the surface area of the deflector, a water flow deflection device is usable for a wider array of boat sizes and powers. Changes in deflector surface area also enables a single water flow deflection device to create wakes with a wider array of features, thus producing wake characteristics suitable for surfers of various sizes, skill and abilities.

Referring now generally to the figures, FIG. **1** illustrates a water flow deflection device **100** attached to a side of a watercraft **10**. While FIG. **1** illustrates an attachable water flow deflection device **100**, the following disclosure is equally applicable to a water flow deflection device **300** that is integral with the hull or a watercraft **10**, such as discussed further with respect to FIGS. **9**A-**9**C.

As the watercraft **10** moves through the water, the water flow deflection device **100** redirects the flow of water outward and away from the side **20** of the watercraft **10** as shown in FIG. **1**. As one of ordinary skill in art will understand and appreciate, a vacuum is created in the water as the watercraft **10** moves forward through the water. This vacuum draws the flow of water back behind the watercraft **10** colliding with the flow of water from the opposing side of the boat **10** and creating a wake **50** behind the watercraft **10**. By redirecting the water away from the side of the watercraft **10**, the water flow deflection device **100** alters the angle at which this redirected flow of water is drawn back behind the watercraft **10**, which pushes up or enhances the flow of water from the opposing side of the watercraft **10** when the two flows merge back together behind the watercraft **10**. Without wishing to be bound by theory, the formation of the wake behind the watercraft **10** is not only dependent upon the speed of the watercraft **10** moving through the water, but also the surface area of the water flow deflection device **100** interacting with the water. The deflector of the wave flow deflection device **100**, **300** of the present invention is adjustable in a vertical direction with respect to the oncoming water, such that a desired angle of interaction between the water flow deflection device **100** and the flow of the oncoming water can be obtained at any desirable speed of the watercraft **100**.

For instance, FIG. **2**A shows a water flow deflection device **100** proximate the side of a watercraft **10** while in a stationary position, whereby the water flow deflection device **100** is substantially perpendicular to the water surface. As the watercraft **10** begins to move through the water, the water flow deflection device **100** continues to be in a substantially perpendicular to the water surface and oncoming water. However, when the watercraft **10** accelerates and gets to a faster speed, the bow of a watercraft **10** typically lifts out of the water with a pronounced tilt or angle from the bow to the aft. This pronounced tilt or angle of the watercraft also affects the angle of interaction between the water flow deflection device **100** and the flow of oncoming water. As shown in FIG. **2**B, the water flow deflection device **100** has an angle of interaction that is no longer substantially perpendicular to the water surface or oncoming water.

The water flow deflection device **100** of the present invention is able to address this altered angle of interaction between the water flow deflection device **100** and the oncoming water by providing a deflector **120** that is capable of being adjustably rotated to provide a desired angle of interaction between the water flow deflection device **100** and the oncoming flow of water. As shown in FIG. **2**C, the deflector **120** of the water flow deflection device **100** is rotated away from the water surface and towards the floor of the body of water, such that when the watercraft **10** is moving through the water at a desired speed with the pronounced tilt or angle from the bow to the aft, the water flow deflection device **100** is now substantially perpendicular to the water surface and the oncoming flow of water, as shown in FIG. **2**D.

Referring now generally to FIGS. **3-7**, the water flow deflection device **100** that is removably attachable to the side of a watercraft and capable of rotatably adjusting the deflector **120** is described. The water flow deflection device **100** generally includes a base plate **110** operably connected to a deflector **120** at an acute angle, preferably between about 30° and about 60°, more preferably between about 40° and about 45°, and the base plate **110** having one or more suction plates **140** for attachment of the water flow deflection device **100** to a watercraft **10**.

Base plate **110** has a proximal end **111** and a distal end **113**, wherein the proximal end **111** is configured to be located towards the bow of the watercraft **10** and the distal end is configured to be located towards the stern of the watercraft **10** when the water flow deflection device is removably attached to the hull of a watercraft **10**. Base plate **110** has a deflector interface **112** located between the proximal **111** and distal **113** ends, wherein deflector interface **112** permits both rotation and secure engagement with deflector **120**.

Base plate **110** may further include one or more apertures **114** that allow for suction plates **140** and deflector **120** to be secured to base plate **110**. In some preferred aspects, as best shown in FIGS. **2-4**, base plate **110** has at least one aperture **114***a* located between the proximal end **111** and deflector interface **112**, and at least one aperture **114***b* located between the distal end **113** and deflector interface **112**, wherein such apertures **114** allow at least two suction plates **140** to be attached to base plate **110**. Base plate **110** also preferably has at least one aperture **114***c* located proximate the center of deflector interface **112**, wherein such aperture **114***c* allows deflector **120** to be attached to base plate **110**. Aperture **114***c* also allows for the rotatable adjustment of deflector **120** with respect to base plate **110**.

In some aspects, proximal end **111** of base plate **110** has a rear edge contour. In some aspects, distal end **113** of base plate **110** has a **117** front edge contour **115**. Front edge contour **115** and rear edge contour **117** may be provided as raised surfaces on the base plate **110** and serve to improve the hydrodynamics of the wave flow deflection device **100**. In some aspects, front edge contour **115** has a semi-circular, oval, single chine, multi-chine or rounded-vee configuration. In some aspects, as shown best in FIG. **4**, at least a portion of the front edge contour **115** is raised relative to base plate **110**, such as front edge protrusion portion **115***a*. Front edge protrusion portion **115***a* may have a protruding height that provides for optimizing hydrodynamic water flow over the plate lock **142** during normal operational use. In some aspects, rear edge contour **117** has a semi-circular, oval, single chine, multi-chine, rounded vee, box or rounded box configuration. In some aspects, as shown best in FIG. **4**, at least a portion of rear edge counter **117** is raised relative to base plate **110**, such as opposing fin protrusion sections **117***a*, **117***b*.

Base plate **110** may also have one or more tether attachment apertures **119**, which allows for securing base plate **110** to watercraft **10** using a connection device such as a lanyard, rope or other connector, such that the water flow deflection device **100** is capable of being secured to the watercraft **10** when suction plates **140** are in an unengaged position. The one or more tether attachment apertures **119** may be located at the proximal end **111** or distal end **113** of base plate **110**. In some aspects, as shown in FIG. **4**, tether attachment apertures **119** are located proximate the proximal end **111** between opposing fin sections **117***a*, **117***b*, such that interaction between the connection device and oncoming water flow to produce the wake is minimized during normal use.

Deflector interface **112** may provide for secure attachment of a deflector **120** to the base plate **110** by operably engaging deflector interface **112** of the base plate **110** with the base plate interface **122** of the deflector **120**. Interface lock **150** may be locked to secure deflector **120** to base plate **110** in the desired position or released to allow rotatable adjustment of deflector **120**.

As shown in FIGS. **4-6**B, deflector interface **112** of base plate **110** has a plurality of concentrically configured teeth **118**, which are capable of operably engaging with a corresponding plurality of concentrically configured teeth **126** of the base plate interface **122** of the deflector **120**. Specifically, the plurality of concentrically configured teeth **118** are capable of operably interlocking with the plurality of concentrically configured teeth **126**, as each of the concentrically configured teeth **118**, **126** have triangular shaped peaks with valleys between each peak, such that the peaks of teeth **118** operably engage with the valleys of teeth **126** and the peaks of teeth **126** operably engage with the valleys of teeth **118**. The operable interlocking of the plurality of concentrically configured teeth **118**, **126** allows secure attachment of deflector **120** to base plate **110** at the desired rotational location and preventing deflector **120** from inadvertently rotating during normal operational use.

The plurality of concentrically arranged teeth **118**, **126** also allow deflector **120** to be rotatably adjusted with respect to base plate **110** in one or more different planes. For example, the plurality of concentrically arranged teeth **118**, **126** may be operably unlocked from each other to allow deflector **120** to be rotatably adjusted, such that deflector face **124** can be adjusted to one of a plurality of angled directions relative to the base plate **110**.

In some aspects with respect to the rotatable adjustment of deflector **120**, base plate **110** defines an X-axis running from the distal end **113** to the proximal end **111** through aperture **114***c*, such that each side of the X-axis is substantially a mirror image of each other, as illustrated in FIGS. **3**A-**3**B. The Y-axis can be defined by a line that passes through pivot aperture **128** of the deflector **120** and aperture **114***c* located proximately the center of deflector interface **112** of base plate **110**, such that Y-axis is perpendicular to X-axis. Deflector **120** is rotatable about the Y-axis, such that the angle of the deflector face **124** is capable of being rotatably changed upon such rotation of deflector **120**. As discussed above, the plurality of concentrically arranged teeth **118**, **126** can be operably interlocked to secure deflector **120** to base plate **110** upon the desired rotation of angle of deflector face **124** having been achieved.

In some aspects, deflector **120** is capable of being rotated to offset the tilt or angle of the watercraft **10** moving through the water during normal operation. In certain aspects, deflector **120** has a normal unrotated position, such that the side edges of the deflector face **124** are substantially parallel to the side edges of base plate **110**, which is illustrated in FIGS. **3**A-**3**B. In some aspects, the normal unrotated position is defined by the top edge of the deflector face **124** being substantially perpendicular to the side edges of base plate **110**. In still some other aspects, the normal unrated position is defined by the deflector **120** being positioned such that the deflector face **124** substantially forms a mirror image of itself with respect to a plane running down the middle of the base plate **110** from the distal end **113** to the proximal end **111**, which is as shown by the X-axis in FIGS. **3**A-**3**B.

The plurality of concentrically arranged teeth **118** on base plate **110** may interlock with coordinating teeth **126** on deflector **120** to provide secure attachment for the deflector **120**. The plurality of concentrically configured teeth **118**,

126 may be configured to permit rotation of deflector 120 in either a clockwise or counterclockwise direction. In some other aspects, the plurality of concentrically configured teeth 118, 126 may be configured to only permit rotation in either the clockwise or counterclockwise direction. In some aspects, plurality of concentrically configured teeth 118, 126 are rotatable by a ratcheting mechanism until the desired deflection angle of deflector 120 is achieved.

In some aspects, deflector 120 is capable of being rotated from 0° to about 30° in either direction about the Y-axis, such that there is a total range of rotational motion of up to about 60°, in some aspect greater than 0° to about 25° in either direction about the Y-axis, such that there is a total range of rotational motion up to about 50°, in some aspects greater than 0° to about 20° in either direction about the Y-axis, such that there is a total range of rotational motion up to about 40°, in some more preferable aspects greater than 0° to about 15° in either direction about the Y-axis, such that there is a total range of rotational motion up to about 30°, from about 1° to about 15° in either direction, and in some aspect from about 3° to about 15° in either direction.

In some aspects, each of the plurality of concentrically arranged teeth 118, 126 of base plate 110 and deflector 120 are capable of rotating the deflector 120 between about 1° and about 15°. For instance, in the situation of each of the plurality of concentrically arranged base plate teeth 118 and deflector teeth 126 having 360 teeth (peaks and valleys), each rotational turn to an adjacent tooth (moving the peak to operably engage with the next adjacent valley) rotates the deflector about 1°, about 2° for each rotational turn about 180 teeth, about 3° for each rotational turn about 120 teeth, about 4° for each rotational turn about 90 teeth, about 5° for each rotational turn about 72 teeth, about 6° for each rotational turn about 60 teeth, about 7.5° for each rotational turn about 48 teeth, about 8° for each rotational turn about 45 teeth, about 9° for each rotational turn about 40 teeth, about 10° for each rotational turn about 36 teeth, about 12° for each rotational turn about 30 teeth, and about 15° for each rotational turn about 15 teeth.

In some preferred aspects, each of the plurality of concentrically arranged teeth of the base plate 118 and corresponding deflector 126 are capable of rotating the deflector 120 between about 4° and about 9°, such that there are between about 40 and about 90 concentrically arranged teeth, more preferably about 5° and about 8°, such that there are between about 45 and about 72 concentrically arranged teeth, most preferably about 7.5°, such that there is about 48 concentrically arranged teeth (48 peaks and 48 valleys) on each of the deflector interface 112 and base plate interface 122, wherein the plurality of concentrically arranged teeth 118, 126 are capable of operably interlocking with each other.

In some aspects, suction plates 140 are operably attached to base plate 110. Suction plates 140 may be configured with a fastener post 144, wherein a separate fastener post 144 passes through each respective aperture 114*a*, 114*b* and may be secured with a lock lever 142. Apertures 114*a*, 114*b* may be sized and shaped to closely align with the size and shape of the fastener post 144. While base plate 110 is depicted with two aperatures 114*a*, 114*b*, it is contemplated that three or more apertures 114 may be utilized to accommodate three or more suction plates 140, or different types of attachments. Suction plates 140 are capable of being attached to watercraft 10 by positioning such plates 140 on watercraft 10 and positioning lock lever 142 from an unattached position to an attached position. Plate locks 142 may be simple lever latches which may be locked to seal suction plates 140 to the hull of a watercraft 10 or released to remove or adjust the water flow deflection device 100.

In some aspects, apertures 114 may be absent, such as in embodiments where base plate 110 is integral with the hull of a watercraft 10. In such embodiments, means of attaching base plate 110 to a hull surface may therefore be unnecessary, as a portion of the hull may comprise base plate 110. In other aspects, suction plates 140 or other means of affixing the base plate 110 may be integral to the base plate 110, such that apertures 114 or equivalent features may therefore be unnecessary to attach the suction plates 140 to the base plate 110. For example, the base plate 110 may attached to a hull using adhesive, or suction plates, hook and loop fasteners, or other attachment means may be attached to or form part of base plate 110.

Tether attachment points 119 on base plate 110 are depicted as apertures in base plate 110 through which a tether may be threaded to attach base plate 110 or the entire water flow deflection device 100 to an attachment point, e.g., a buoy or a cleat on a dock or watercraft. In certain embodiments, tether attachment points 119 may take any form which permits securing of base plate 110, such as a hook, arch, loop, etc. In certain embodiments, there may be one, two, three or more tether attachment points 119, or in some other aspects, tether attachment points 116 may be absent. In some other aspects, one or more tether attachment points 119 may be provided on deflector 120.

Base plate 110 may be further configured with various alignment guidance features 116 for indicating to a user the rotational adjustment when the water flow deflection device 100 is attached to the port or star side of the watercraft 10. The alignment guidance features 116 may be located on base plate 110 between the deflector 120 and the distal end 113 and/or between the deflector 120 and the proximal end 111. Alignment guidance features 116 can indicate to a user the rotational adjustment of deflector 120 to base plate 110 when the water flow deflection device is used for a water surfer having regular foot positioning or goofy foot positioning.

Deflector interface 112 not only provides deflector 120 with a secure attachment point to base plate 110, but also the necessary rotational freedom to permit vertical adjustment by a user of the angle between the deflector face 124 and the oncoming water flow or surface of the water. Deflector interface 112 may generally be integrally molded with the body of base plate 110, including integral features such as the plurality of concentrically arranged teeth 118. Teeth 118 and aperture 114*c* may be formed by molding, pressing, machining, or any other integral or reductive method of formation. Such methods may generally be preferred to provide a unitary base plate 110 body, however in embodiments a more piecemeal construction may be desired, e.g., for ease of parts replacement, and additive methods of formation may instead by used. For example, concentrically arranged teeth 118 may be separate components and customizable by a user to be specific to achieve a desired configuration of the water flow deflection device.

Other features of base plate 110, such as apertures 114*a*, 114*b*, front and rear contours 115, 117, and tether attachment features 119 may also be integrally formed with base plate 110, such as by molding, pressing, or machining. Alignment guidance features 116 may be integral or applied as an additional component. They may be etched, pressed, painted, applied as decals, or the like.

Aperture 114*c* centrally located in deflector interface 112 provides a passage in the base plate 110 for pin 152 to pass through and secure deflector 120 to base plate 110. In certain embodiments, aperture 114*c* in deflector interface 112 may

be sized and shaped to securely hold a pin or post with tight clearances. In certain embodiments, aperture **114***c* may be sized and shaped to permit a pin or post to rotate within aperture **114***c*. In other aspects, aperture **114***c* may be sized and shaped to prevent a pin or post from rotating within aperture **114***c*, but instead, the pin or post may rotate within pivot channel **128** of deflector **120**.

Alignment guidance features **116** provide a user assistance in orienting the water flow deflection device **100** on the hull of a watercraft **10**. Alignment guidance features **116** may indicate which direction to orient the distal and proximal ends **113**, **111** of the water flow deflection device **100** towards in relation to the watercraft **10** for a surfer's preferred orientation (left foot, regular, or right food, "goofy," forward). Alignment guidance features **116** may also indicate which direction to rotationally adjust deflector **120** in relation to the bow of the watercraft depending upon whether the water flow deflection device **100** is mounted on the port or starboard side of the watercraft **10**. Alignment guidance features **116** may also have rotational adjustment indicia pertaining to where deflector **120** is at an unrotated position and also one or more rotational positions. In certain aspects, the alignment guidance features **116** will provide an unrotated position and two or more rotational positions in each direction from the unrotated position. In certain aspects, deflector **120** has an alignment guidance feature **125** that operably aligns with a corresponding alignment feature **116** on base plate **110** to indicate to a user whether the deflector **120** is at an unrotated position or one of the two or more rotational positions.

In certain embodiments, alignment guidance features **116**, **125** may appear as pictures, symbols (such as arrow, notches or the like), written words, or any other appropriate indicia means of indicating proper alignment to a user. In certain embodiments with rotationally adjustable deflector **120**, additional alignment guidance features **116**, **125** may mark particular settings of the deflector **120** to assist a user in successful quick mounting and alignment of the water flow deflection device **100** following an initial determination of the proper orientation and setting for a particular watercraft **10**.

The deflector interface **112** of base plate **110** may further incorporate a raised outer ring **131**. In embodiments, raised outer ring **131** may only partially circumscribe deflector interface **112**, such that alignment feature **125** of deflector **120** interacts with raised outer ring **131** to limit the rotation of deflector **120**.

In aftermarket embodiments, suction plates **140** secure water flow deflection device **100** to a hull of watercraft **10** when plate locks **142** are in the locked position. When plate locks **142** are in the open position, suction plate **140** will release from the watercraft hull and allow for adjustment of the arrangement of the base plate **110** on the watercraft's hull. The suction plates **140** allow for fast and efficient installation of the water flow deflection device **100** and adjustment of the base plate **110** placement and angle on the hull of watercraft **10**. Easy adjustment of base plate **110** on the hull of watercraft **10** provides for one means of adjustment of water depth placement and contact angle of deflector **120**-to maximize the surfable wake, as well as changing sides, e.g., for a goofy footed rider. Vertical placement and adjustment of base plate **110** on the hull of a watercraft **10** may enable the water flow deflection device **100** to be set at water level when the watercraft **10** is at surfing speed, and adjusted according to different ballast levels of a watercraft **10** (e.g., changes in the number of passengers) and different surfer's preferred wake surfing speed. Horizontal placement and adjustment of base plate **110** on the hull of a watercraft **10** between the bow and stern may enable the user to achieve the ideal distance from the stern of the watercraft **10** to produce the maximum surfable wake. If deflector **120** is non-adjustably fixed to base plate **110**, then adjustment of base plate **110** angle on the hull of watercraft **10** may also enable deflector **120** to properly contact the water's surface to produce a desired surfable wake.

In certain embodiments, deflector **120** may be configured to rotate vertically and thus adjust the angle of contact with the oncoming water, making achievement of the ideal angle and production of the desired surfable wake easier. Rotational adjustment of deflector **120** with the flow of oncoming water for water flow deflection device **100** attached to the hull of watercraft **10** permits faster, easier adjustments to get the desired deflector angle and wake characteristic than detaching the water flow deflection device **100** from the watercraft **10** and repositioning at a desirable horizontal and vertical location on the hull. Rotational adjustment of deflector **120** also enables quick adjustment for a variety of changes to watercraft **10**, including weight, weight distribution, speed, desired wake size and shape, and the like.

Suction plates **140** may comprise rubber overmolds **148** operably engaged with an overmold plate **144** located on the bottom of base plate **110**. Overmold plate **144** may comprise a base to which rubber overmold **148** operably attaches, such as a flat disc, and have a central post **145** emerging perpendicularly from overmold plate **144** that operably engages through aperture **114***a* or **114***b* and attaches to suction plate lock lever **142** located on the top of base plate **110** via clevis pin **146**. Each of lock levers **142** are configured to engage suction plates **140** when depressed (pressed parallel to base plate **110**) by drawing up overmold plate **144** and creating a concave shape in rubber overmold **148**, thus forming a suction. Such plates **140** are configured to release the suction by lifting lock lever **142** and operably pushing overmold plate **144** away from base plate **110**.

Interface lock **150** provides for secure attachment of deflector **120** to base plate **110**. Interface lock **150** may also permit release of deflector **120** from base plate **110**, such as for rotatable adjustment deflector **120** relative to base plate **110**. Interface lock **150** may provide for secure engagement of base plate interface **122** with a corresponding deflector interface **112** in the base plate **110**. Interface lock **150** comprises deflector pin **152**, which secures deflector **120** to the base plate **110** by deflector pin **152** passing from the bottom side of base plate **110** through aperture **114***c* in base plate **110** and pivot channel **128** of deflector **120** to the top side of base plate interface **122**. Deflector pin **152** may be secured to lock lever **158** on the top side of base plate interface **122** with clevis pin **156** in similar manner as that of suction plates **140**. In certain aspects, a washer **154**, which may be added at the distal end of deflector pin **152**, is flat and configured to distribute the applied tension when lock lever **158** is operably engaged to a locked position securing deflector **120** to base plate **110** at the desired position.

Referring now to FIGS. **3**A and **6**A, deflector **120** comprises deflector face **124** having a textured surface, which may allow the flow of oncoming water to flow quicker off the deflector face **124** as the watercraft **10** moves through the water. In certain aspects, the textured surface of deflector face **124** comprises a plurality of concave dimples **124***a*. Dimples **124***a* may comprise a variety of shapes and sizes. In some aspects, dimples **124***a* are generally hexagonally shaped. In some aspects, dimples **124***a* comprise two or more different sized generally hexagonally shaped concave dimples.

In some aspects, at least 10% of deflector face **124** comprises a concave textured surface, in some aspects at least 15%, in some aspects at least 25%, and in some aspects at least 30%. In some aspects, between about 10% and about 95% of the surface area of deflector face **124** comprises a concave textured surface, in some aspects between about 15% and about 85%, in some aspects between about 20% and about 75%, and in some aspects between about 25% and about 65%. In some aspects, the concave textured surface has a surface area that is greater than the flat surface of deflector face **124**.

In some aspects, deflector face **124** comprises one or more alignment guidance feature **125***b*. The one or more alignment guidance feature **125***b* may be formed or molded as part of deflector face **124** or later machined, carved, painted, or otherwise applied to deflector face **124**. Alignment guidance features **125***b* may correspond with an associated base plate alignment guidance feature **116** located between deflector **120** and proximal end **111** of base plate **110** to assist a user in achieving the desired rotational alignment of deflector **120**. Desired rotational alignment of deflector **120** may depend on a rider's skill, a rider's preference for regular or goofy, weather conditions, boat size, engine size, current or target ballast for skiing, and the like. In some aspects, alignment guidance features **125***b* in conjunction with corresponding alignment guidance feature **116** indicate to a user which direction to rotationally adjust deflector **120** depending upon whether the user's preference is regular or goofy foot for surfing.

Deflector **120** may also have one or more alignment guidance feature **125***a* located on the proximal side of deflector **120** to operably engage with one or more alignment features **116** located between deflector **120** and proximal end **111** of base plate **110**. Alignment guidance feature **125***a* may provide a user with an indication of the rotation of deflector **120** relative to base plate **110** and assist in achieving a desired rotational angle. In certain embodiments, one or more coordinating alignment guidance features **116** or raised outer rim **131** may be provided on base plate **110**, with which alignment guidance feature **125***a* may align to assist the user in identifying when deflector **120** is appropriately rotationally positioned. Raised outer rim **131** may be configured to only circumscribe a portion of deflector interface **112**, such that rim **131** may interfere with alignment feature **125***b* such that the engagement between deflector interface **112** and base plate interface **122** outside of desired angles is prevented.

It may generally be preferable for deflector **120** to be aligned at a slight downward angle relative to the hull of the watercraft **10** when the watercraft **10** is at rest, as shown in FIG. **2**C, such that when the watercraft **10** is brought up to speed deflector **120** is substantially perpendicular to the flow of oncoming water. The one or more alignment guidance features **125** on deflector **120** may be particularly configured to achieve such a downward angle with respect to one or more alignment guidance features **116** on base plate **110**. Alignment guidance features **116**, **125** may provide a range of indications, such that the precise desired angle for a wide variety of watercraft sizes, powers, and rider preferences may be covered by the provided indications.

In some aspects, deflector face **124** may be provided in substantially the same plane. In some other aspects, as shown best in FIGS. **3**A, **3**B, **4** and **6**A, deflector face **124** may have a central portion that is in a different plane than the outer portions. Deflector face **124** may comprise one or more guide ridges **130** that provide a transition between the plane of the central portion and the plane of the outer portions. Guide ridges **130** may also correspond with alignment guidance features **116** on base plate **110**. The central portion of deflector face **124** may have a central channel **132** with a centrally located aperture **134** and a plurality of teeth **136** (peaks and valleys). The central channel **132** being capable of receiving an inset cover **160**. In some aspects, inset cover **160** is about the same thickness as central channel **132**, such that when received within central channel **132** inset cover **160** is substantially in the same plane as the central portion of deflector face **124**. Inset cover **160** may have a plurality of teeth **162** that operably interlock with the plurality of teeth **136** of the central channel **132**. Inset cover **160** may also have a securing aperture **164**, such that a fastener such as a screw may be operably inserted through centrally located aperture **134** on the backside of deflector **120** to secure inset cover **160** to deflector **120** within central channel **132**.

FIG. **7** provides a flowchart of an example method **180** of using water flow deflection device **100**, according to embodiments of the present disclosure. In some aspects, a user of the water flow deflection device **100** may generally begin by aligning **182** the water flow deflection device **100** on one side of the hull of a watercraft **10**. In some aspects, the water flow deflection device **100** may be mounted as near the stern of the watercraft **10** as possible, on a fully submerged flat and smooth surface. In certain aspects, the water flow deflection device **100** has optimal performance when mounted about 3 to about 4 inches below the water line and as near the back of the hull as possible. Once located in the desired vertical and horizontal locations of the watercraft **10**, the water flow deflection device **100** is then secured to the hull **184** by operably engaging the suction plates **140**. In certain embodiments, the water flow deflection device **100** is secured to the hull by pressing the device firmly against the hull and locking the suction plate levers **142** into the securing position. The locked position of the suction levers **142** may be achieved when the levers are substantially parallel to the base plate and the hull.

The rotational angle of deflector **120** may be rotationally adjusted before and/or after water flow deflection device **100** is secured to the hull of watercraft **186**. In some aspects, the rotational angle of deflector **120** is adjusted after water flow deflection device **100** is secured to the hull of watercraft **10**. In some other aspects, rotational angle of deflector **120** is adjusted before water flow deflection device **100** is secured to the hull of watercraft **10**. In either instance, interface lock **150** is operably disengaged to allow rotational adjustment of deflector **120**. Interface lock **150** is operably engaged once deflector **120** is engaged in the desired rotational angle.

Adjusting deflector surface area **188** is discussed in more detail below in reference to example embodiment **200** in FIGS. **8**A-**8**D.

Referring now generally to FIGS. **8**A-**8**D, another embodiment of a water flow deflection device **200** of the present invention is illustrated. The water flow deflection device **200** illustrated in FIGS. **8**A-**8**D has an adjustably extendible deflector assembly **220** operably coupled to base plate **210**. The adjustably extendible deflector assembly **220** generally comprises a base deflector **221** and an overlaying extension deflector **223**. Extension deflector **223** overlays base deflector **221** and is slidably adjustable from a retracted position to a fully extended position with one or more intermediate extended positions between the retracted position and the fully extended position. Extension deflector **223** has a centrally located channel **225** with a centrally located channel aperture **226**, and base deflector **221** has a centrally located aperture **234** (base deflector **221** may generally be substantially similar to deflector **120** of FIGS. **3**A-**6**B, and

aperture **234** may be substantially equivalent to aperture **134** in FIG. **6**A), wherein aperture **234** and channel **225** with channel aperture **226** operably engage with securing assembly **240** for securing extension deflector **223** with base deflector **221** at the desired position, whether the retracted position, one or more intermediate extended positions, or the fully extended position.

Securing assembly **240** comprises pin **242** that transverses through channel **225** and aperture **222** and connects with locking lever **244** via clevis pin **246**. Locking lever **244** can be in an unlocked position that allows the slidable adjustability of extension deflector **223** or a locked position that prevents the slidable adjustability of extension deflector **223**. Locking lever **244** in the unlocked position allows extension deflector **223** to slidably adjust by extending away from base plate **210** or retracting towards base plate **210** by allowing pin **242** to slide within channel **225**. In certain aspects, the head **242***a* of pin **242** located on deflector face side of extension deflector **223** fits within channel **225** and is larger than aperture **234**, such that pin **242** allows for the slidable adjustability of extension deflector **223**. Once extension deflector **223** is provided at the desired position, locking lever **244** can be operably engaged to a locked position, which prevents any further slidable adjustment of extension deflector **223** during normal operational use. In some aspects, the unlocked position of locking lever **244** is achieved by pulling locking lever **244** away from the backside of base deflector **221** and relieving the tension pressure. In some aspects, the locked position of locking lever **244** is achieved by pushing locking lever **244** towards the backside of base deflector **221** to operably engage the tension pressure. In some aspects, the locked position of locking lever **244** is achieved by locking lever **244** being in a substantially parallel configuration to base deflector **221** and extension deflector **223**, while the unlocked position of locking lever **244** is achieved by locking lever **244** being in a substantially perpendicular configuration to base deflector **221** and extension deflector **223**.

In some aspects, extension deflector **223** may have a top edge **223***b* that is substantially perpendicular to the extension deflector face **223***a*. Top edge **223***b* allows an operable engagement point for a user to pull or push on extension deflector **223** until the desired extended or retracted position is reached. In the retracted position, top edge **223***b* may operably engage with the top edge of base plate **210**.

In some aspects, the range of extension is limited by the length of channel **225**. In the retracted position, head **242***a* of pin **242** operably engages with a proximal end **225***a* of channel **225**. In the fully extended position, head **242***a* of pin **242** operably engaged with a distal end **225***b* of channel **225**. In the one or more intermediate extended positions, head **242***a* of pin **242** is located between the proximal and distal ends **225***a*, **225***b* of channel **225**.

In some aspects, extension deflector **223** may comprise one or more extension indicia **235** located on the backside of extension deflector **223**. In some aspects, the one or more extension indicia **235** operably interact with the top edge of base deflector **221** to indicate to the user the retracted or extended position of extension deflector **223**. In some preferred aspects, extension deflector **223** comprises a plurality of extension indicia **235** located on the backside that align with the top edge of base deflector **221** to indicate to a user whether the extension deflector **223** is in the retracted position, fully extended position or one or more intermediate extended positions. In some aspects, the plurality of extension indicia **235** contain numerals and/or markings for ease of extension adjustability to a desired setting.

In some aspects, the width of extension deflector **223** is substantially the same width of base deflector **221**, such that the width of the deflector assembly **220** is about the same whether the extension deflector **223** is in the retracted position, fully extended position or one or more of the intermediate extended positions.

In some aspects, base deflector **221** has deflector face **224** (substantially similar to face **124** of FIG. **6**A), which has the same contoured configuration as deflector face **124** discussed above with respect FIGS. **3**A, **3**B, **4** and **6**A. Deflector face **224** may have a central portion that is in a different plane than the outer portions. Deflector face **224** may comprise one or more guide ridges **230***a* (substantially similar to guide ridges **120** of FIG. **6**A) that provide a transition between the plane of the central portion and the plane of the outer portions. Guide ridges **230***a* operably interact with guide ridges **230***b* located on the backside of extension deflector **223**, which helps provide the extension deflector **223** in a slidable track configuration with respect to base deflector **221** and prevent extension deflector **223** from sliding in a direction other than towards and away from base plate **221**, such as to prevent sliding in a transverse direction. Guide ridges **230***a* may also correspond with alignment guidance features on base plate **210**.

The central portion of deflector face **224** may have at least one central channel **232** with a centrally located aperture **234** and a plurality of teeth **236** (peaks and valleys) (substantially similar to central channel **132**, aperture **134**, and teeth **136** of FIG. **6**A). In some aspects, central channel **232** is proximately located the center of deflector face **224**. Central channel **232** is capable of receiving a protruding portion **227** of extension deflector **223**. Protruding portion **227** may have a plurality of teeth **229** that operably interlock with the plurality of teeth **236** of the central channel **232**. The interlocking plurality of teeth **236**, **229** may help prevent extension deflector **223** from slidably extending during normal use.

In some aspects, central channel **232** extends from a bottom portion of deflector face **224** to an upper portion. In some aspects, central channel **232** extends the entire distance from a bottom portion to the top edge of base deflector **221**, such as deflector **120** shown in FIG. **6**A. Central channel **232** extending the entire distance from a bottom portion to the top edge of deflector face **224** allows a portion of protruding portion **227** to operably engage with the top edge in the fully extended position and one or more of the intermediate extended positions.

As illustrated in FIGS. **8**A-**8**D, centrally located channel aperture **226** extends from centrally located channel **225** through protruding portion **227**, such that channel aperture **226** is centrally located within protruding portion **227** and the plurality of teeth **229**. In some aspects, protruding portion **227** allows extension deflector **223** to slidably extend and retract with respect to base deflector **221** in a direction extending away from and towards base plate **210** while preventing extension deflector **223** from sliding in a transverse direction.

In some aspects, deflector assembly **210** having the adjustably extendible aspect is also rotatably adjustable with respect to the base plate **210** as discussed above. In such embodiments, base deflector **221** is operably rotatable with respect to base plate **210**.

In some aspects, deflector assembly **210** has a textured deflector face as discussed above. In some aspects, base deflector **221**, extension deflector **223**, or both the base deflector **221** and extension deflector **223** have a textured deflector face. In some aspects, only a portion of base

deflector **221** that is not overlayed by extension deflector **223** when extension deflector **223** is in the fully extended position has a textured deflector face. In some aspects, the entire deflector face of base deflector **221** and/or extension deflector **223** comprises a textured face. In some aspects, the textured face comprises a plurality of dimples. In some aspects, the textured face comprises a plurality of hexagonally shaped dimples. In some other aspects, the textured face comprises a plurality of geometrically shaped concave indentations.

The example method **180** of FIG. **7** may also apply to using water flow deflection device **200**, according to embodiments of the present disclosure. In some aspects, a user of the water flow deflection device **200** may generally begin by aligning **182** the water flow deflection device **200** on one side of the hull of a watercraft **10**. In some aspects, the water flow deflection device **200** may be mounted as near the stern of the watercraft **10** as possible, on a fully submerged flat and smooth surface. In certain aspects, the water flow deflection device **200** has optimal performance when mounted about 3 to about 4 inches below the water line and as near the back of the hull as possible. Once located in the desired vertical and horizontal locations of the watercraft **10**, the water flow deflection device **200** is then secured to the hull **184** by operably engaging the suction plates. In certain embodiments, the water flow deflection device **200** is secured to the hull by pressing the device firmly against the hull and locking the suction plate levers into the securing position. The locked position of the suction levers may be achieved when the levers are substantially parallel to the base plate and the hull.

The surface area of the deflector assembly **220** may be slidably adjusted before and/or after water flow deflection device **200** is secured to the hull of watercraft **188**. In some aspects, the surface area of deflector assembly **220** is adjusted after water flow deflection device **200** is secured to the hull of watercraft **10**. In some other aspects, the surface area of deflector assembly **220** is adjusted before water flow deflection device **200** is secured to the hull of watercraft **10**. In either instance, extension deflector **223** may be retraced or extended to the desired position with respect to base deflector **221**. In some aspects, the deflector assembly **220** may also be rotationally adjusted prior to or after the water flow deflection device **200** is secured to the hull of watercraft **10**. Deflector assembly **220** may also be rotationally adjusted prior to or after the surface area adjustment of deflector assembly **220**. After proper surface area and/or rotational adjustments, watercraft **10** may move in a forward direction to generate a wake behind the watercraft, such that a wake surfer may utilize the wake for wake surfing.

In certain other embodiments as illustrated in FIGS. **9**A-**9**C, water flow deflection device **100**, **200** may be integral with watercraft **10** and controlled onboard by the watercraft operator utilizing a controller and display. In such instances, the operator of watercraft **10** may control the water flow deflection device **100** onboard with at least one actuator secured on the watercraft and operably connected to the controller. The actuator may be a linear actuator including electric motors, hydraulic motors, pneumatic motors, or the like. Preferably the actuators are watertight or water resistant, and more preferably waterproof. The actuator is configured to push the deflector **120** from an inset of the hull at an inner retracted position and away from the hull to an outer extended position until the deflector **120** reaches a desired oncoming angle to generate a wake. In some aspects, the deflector **120** at the outer extended position is at an angle between about 30° to about 60°, most preferably between about 30° and about 45°. Deflector **120** can also be pivotally mounted to the actuator to allow rotatable adjustment of deflector face with respect to oncoming water. In some aspects, the proximal end of deflector **120** is pivotally mounted to the actuator and distal end of deflector **120** is mounted to a rotatable actuator for adjusting the rotational angle of deflector **120**. The operator on watercraft **10** may manually control the rotational angle of deflector **120** using a control panel with display. In some other aspects, deflector interface **112** may further comprise a motor permitting adjustment of the deflector **120**. In some other aspects, deflector interface **112** may further comprise a receiver for receiving commands for the operation of the motor. In some other aspects, the deflector orientation may be automatically adjusted in response to a signal indicating the angle of the deflector face with respect to the oncoming water flow. For instance, a gyroscope indicating the orientation of the deflector relative to the water's surface or relative to the location of the water flow deflection device may be utilized to provide real-time signal orientation to the controller. In some aspects, the operator of the watercraft may control the desired deflection device rotational angle and select a manual mode whereby the deflection device is kept at that orientation or automatic mode whereby the deflection device automatically rotationally adjusts while the watercraft is moving. One will appreciate that the rotational actuator may be configured to accommodate a wide variety of rotational angles of the deflector in manual mode as well as maintaining a specific rotational angle or rotational angle range during automatic mode. In some aspects, the rotational angle range may be maintained within about ±10°, in some aspects about ±7.5°, in some aspects about ±5°, and in some aspects about ±3° while the watercraft **10** is in normal operational use.

In another aspect, the wake shaping device may be configured to accommodate hull designs with limited space for attachment. For example, the size of the suction plates, or other means of attachment, may be reduced to permit attachment to a narrower portion of the hull. Embodiments may use an increased number of suction plates to offset the reduced holding power of the smaller suction plates. Such a design may be particularly advantageous for boats with narrower hull lines or stepped hulls.

In another aspect, the wake shaping device may be configured to accommodate hull designs with limited space for attachment. For example, the size of the suction plates, or other means of attachment, may be reduced to permit attachment to a narrower portion of the hull. In some other aspects, an increased number of suction plates may be used to offset the reduced holding power of the smaller suction plates. In some aspects, the size of the base plate may also need to be minimized. Such a design may be particularly advantageous for boats with narrower hull lines or stepped hulls.

Referring now generally to FIG. **10**A and FIG. **10**B, a water flow deflection device **300** having a slim line configuration is shown according to embodiments of the present disclosure. The slim line configuration device **300** may comprise a base plate **310**, a deflector **320** and two or more suction plate assemblies **340**, much like the water flow deflection device **100** illustrated in FIGS. **1**A-**1**B.

In some aspects of the slim line configuration device **300**, base plate **310** is configured as a narrow rectangle or oblong shape and may generally have deflector **320** oriented rearward of center of the base plate **310**, such that a greater portion of the base plate extends toward the stern of the watercraft from the proximate location of the deflector **320**

operably attaching to the base plate **310** than toward the bow of the watercraft when the device **300** is mounted to the hull. This slim line configuration places a greater portion of the suction plate assemblies **340** on the base plate in a location to offset the force of the oncoming water against the deflector and ensures base plate **310** remains affixed to the hull. Various embodiments are envisioned, with diverse numbers of suction plate assemblies or other means of attachment, but it may generally be preferable for a greater portion of the attaching means to be focused to the stern-side of the water flow deflecting device **300**. Embodiments with a centrally located deflector **320** or the deflector **320** on the stern side of base plate **310** are nonetheless envisioned.

In some aspects, base plate **310** has a proximal end and a distal end, wherein the proximal end is configured to be located towards the bow of the watercraft and the distal end is configured to be located towards the stern of the watercraft when the water flow deflection device **300** is attached to the watercraft. Base plate **310** may include one or more apertures that allow for suction plate assemblies **340** to be secured to base plate **310**.

In some preferred aspects, base plate **310** has at least three apertures located between the proximal end and a proximate location of deflector **320** operably engaging with base plate **310**, and at least one aperture located between the distal end and the proximate location of deflector **320** operably engaging with base plate **310**, wherein such apertures allow at least four suction plate assemblies **340** to be attached to base plate **310**.

In some aspects, suction plate assemblies **340** each have diameter of less than 3.5 inches, in some aspects about 3 inches, such that a width of base plate **310** may be as less than about 4.0 inches, in some aspects less than about 3.75 inches, and in some preferred aspects less than about 3.5 inches. In certain aspects where a narrower base plate is required, which requires even smaller sized suction plate assemblies **340**, then the water flow deflection device **300** may contain more than four suction plate assemblies **340**. In of ordinary skill in the art will appreciate that with the narrower the base plate **310**, the smaller and more suction plate assemblies **340** may need to be employed.

Each suction plate of the suction plate assembly **340** may be independently secured with a lock lever **342**, though other means of attaching suction plates to base plate **310** are envisioned. Other means of securing slim wake shaping device **300** are also envisioned as well, including but not limited to a unitary lock lever system wherein two or more suction plates may be secured at one time.

In some aspects, deflector **320** has a width generally wider than the width of the base plate. In certain aspects, the width of the deflector may be two to three or more times greater than the width of the base plate, depending on the speed and power of the vessel and the design and shape of the hull. In some aspects, the deflector **320** may have a first width defined by the proximate location of the leading end of deflector **320** operably engaging with base plate **310** with a second width defined by the trailing end of deflector **320**, the midway point between trailing and leading ends, or the widest portion of deflector **320**.

In some aspects, a ratio of a first deflector width proximate the widest portion of deflector face to a second deflector width proximate the location of engagement with base plate **310** may be at least about 1.25:1, in some aspects at least about 1.5:1, in some aspects at least about 2:1, in some aspects at least about 2.25:1, and in some other aspects at least about 2.5:1. In some aspects, the ratio of the first deflector width to the second deflector width is between about 1.25:1 to about 5:1, in some aspects between about 1.5:1 to about 4:1, and in some aspects between about 2:1 to about 3:1. In an exemplary embodiment, the deflector **320** proximate the engagement with base plate **310** is about 3.5 inches and the deflector **320** proximate the midway point between the leading and trailing ends is about 8 inches. In some aspects, the trailing end is also about 8 inches. In certain preferred aspects, the width of the deflector **320** proximate the midway point and/or the trailing end is greater than the width of the deflector **320** proximate the engagement point with base plate **310**.

In some aspects, base plate **310** is between about 10 inches to about 20 inches in length, in some aspects between about 11 inches and about 18 inches, and in some preferred aspects between about 12 inches and about 16 inches.

Deflector **320** may generally have a non-uniform hexagonal shape, with a narrow side to match the width of the base plate **310**, two additional narrow sides to allow the deflector **320** angle or flare from the base to the opposing sides of the non-uniform hexagonal shape. In some preferred aspects, deflector **320** has a symmetrical shape. The taper angle between the opposing sides of deflector **320** to the location proximate deflector **320** operably engaging with base plate **310** allows the face of deflector **320** to be substantially wider than the width of base plate **310**.

In certain aspects, deflector **320** may have a textured face. For example, the face may have a dimpled textured to optimize its hydrodynamic properties. The dimpled texture may comprise a plurality of depressions in the face of the deflector. The depressions may have a variety of shaped, but may generally be round, producing a roughly spheroid indent in the face of the deflector and having a circular or hexagonal boundary on the surface of the face. The depressions may be uniform or varying in size. Certain preferred embodiments may have a dimple texture where the depressions are substantially one of two dimensions, wherein one set of dimensions is larger than the other, producing a dimpled texture with a mixture of large and small depressions.

Base plate **310** may additionally comprise a deflector interface located between the proximal and distal ends, wherein the deflector interface permits both rotation and secure engagement of deflector **320**. Base plate **310** may also have at least one aperture located proximate the center of the deflector interface, wherein such aperture allows deflector **320** to be attached to base plate **310**.

Deflector **320** may be affixed to the base plate **310** by being unitarily molded with the base plate, or deflector **320** and base plate **310** may be formed separately and attached, for example in embodiments with a movable deflector. Deflector **320** may be affixed to the base plate such that it extends substantially perpendicular to the hull of the watercraft with the deflection device is attached. Deflector **320** may be arranged so that the face of the deflector forms a substantially right or obtuse angle to the base plate, such that the face of the deflector achieves a desired contact angle with the oncoming water when the watercraft comes up to speed. For example, the angle between the base plate and the face of the deflector may be 90 degrees, 100 degrees, 110 degrees, 120 degrees, etc. The rear side of the deflector, or the non-face side, is at a substantially acute angle relative to the base plate **310**, and the angle may be filled in some embodiments, such as with the same marine grade polymer which may be used to form the deflector and base plate, to provide additional support for the deflector **320**. The primary support for the deflector **320** is a vertical supporting which

rises from the base plate **310** at a right angle and connects to the rear-side of the deflector.

Embodiments may be formed using a variety of sturdy materials, such as wood, metal, or certain plastics, but certain preferred embodiments may be formed using marine grade polymer. Desirable characteristics for materials may include buoyancy, to assist recovery of the device in water.

Various embodiments of systems, devices, and methods have been described herein. These embodiments are given only by way of example and are not intended to limit the scope of the claimed inventions. It should be appreciated, moreover, that the various features of the embodiments that have been described may be combined in various ways to produce numerous additional embodiments. Moreover, while various materials, dimensions, shapes, configurations and locations, etc. have been described for use with disclosed embodiments, others besides those disclosed may be utilized without exceeding the scope of the claimed inventions.

Persons of ordinary skill in the relevant arts will recognize that the subject matter hereof may comprise fewer features than illustrated in any individual embodiment described above. The embodiments described herein are not meant to be an exhaustive presentation of the ways in which the various features of the subject matter hereof may be combined. Accordingly, the embodiments are not mutually exclusive combinations of features; rather, the various embodiments can comprise a combination of different individual features selected from different individual embodiments, as understood by persons of ordinary skill in the art. Moreover, elements described with respect to one embodiment can be implemented in other embodiments even when not described in such embodiments unless otherwise noted.

Although a dependent claim may refer in the claims to a specific combination with one or more other claims, other embodiments can also include a combination of the dependent claim with the subject matter of each other dependent claim or a combination of one or more features with other dependent or independent claims. Such combinations are proposed herein unless it is stated that a specific combination is not intended

Any incorporation by reference of documents above is limited such that no subject matter is incorporated that is contrary to the explicit disclosure herein. Any incorporation by reference of documents above is further limited such that no claims included in the documents are incorporated by reference herein. Any incorporation by reference of documents above is yet further limited such that any definitions provided in the documents are not incorporated by reference herein unless expressly included herein.

For purposes of interpreting the claims, it is expressly intended that the provisions of 35 U.S.C. § 112(f) are not to be invoked unless the specific terms "means for" or "step for" are recited in a claim.

What is claimed is:

1. A water flow deflection device configured to be attached to a side of a watercraft for the enhancement of a watercraft wake, the water flow deflection device comprising:

an elongated base with a first end and a second end, the elongated base configured to be aligned along the side of the watercraft when the water flow deflection device is attached to the watercraft, and the elongated base having a deflector interface;

a deflector assembly operably attached to the base between the first and second ends of the elongated base, the deflector assembly comprising a deflector face spanning between a leading end and an opposing trailing end, the leading end extending in an outward direction away from the elongated base at an acute angle to the opposing trailing end, the deflector face having a surface area configured to deflect water, the leading end being in closer proximity to the watercraft than the trailing end during operational use on the watercraft, and the deflector assembly comprising a base interface; and

two or more suction cup assemblies attached to the elongated base, a first suction cup being attached to the elongated base proximately located between the first end and the deflector interface, a second suction cup being attached to the elongated base proximately located between the second end and the deflector interface, and the first and second suction cups configured to provide removable attachment of the elongated base to the watercraft;

wherein the deflector interface and the base interface are operably coupled and configured to allow a rotational adjustment of the deflector face relative to the elongated base.

2. The water flow deflection device of claim **1**, wherein the rotational adjustment of the deflector face relative to the elongated base is between about 0° to about 30° in either direction.

3. The water flow deflection device of claim **2**, wherein the rotational adjustment of the deflector face relative to the elongated base provides a total range of rotational motion of up to about 60°.

4. The water flow deflection device of claim **1**, wherein the rotational adjustment of the deflector face relative to the elongated base is between about 0° to about 22.50° in either direction.

5. The water flow deflection device of claim **4**, wherein the rotational adjustment of the deflector face relative to the elongated base provides a total range of rotational motion of up to about 45°.

6. The water flow deflection device of claim **1**, further comprising an interface lock that is capable of operably locking the deflector interface and base interface at a desired rotational position of the deflector face relative to the elongated base.

7. The water flow deflection device of claim **1**, wherein the deflector interface having a first concentrically-shaped configuration and the base interface having a second concentrically-shaped configuration, such that the first concentrically-shaped configuration of the deflector interface and the second concentrically-shaped configuration of the base interface are configured to be operably coupled and allow the rotational adjustment of the deflector face relative to the elongated base.

8. The water flow deflection device of claim **7**, further comprising an interface lock that is capable of operably locking the deflector interface and base interface at a desired rotational position of the deflector face relative to the elongated base.

9. The water flow deflection device of claim **1**, wherein the deflector interface having a first plurality of concentrically arranged teeth and the deflector assembly having a base interface having a second plurality of concentrically arranged teeth, and wherein the first plurality of concentrically arranged teeth of the deflector interface and the second plurality of concentrically arranged teeth of the base interface are configured to operably interlock with each other at a desired rotational position of the deflector face relative to the elongated base.

10. The water flow deflective device of claim 1, further comprising one or more rotational alignment guidance indicia proximately located the base interface or the deflector interface.

11. The water flow deflection device of claim 1, wherein the deflector face has a textured surface.

12. The water flow deflection device of claim 11, wherein the textured surface of the deflector face comprises a plurality of concave indentations.

13. The water flow deflection device of claim 1, wherein the deflector assembly comprises a base deflector operably attached to an extendible deflector that is capable of slidably adjusting the surface area of the deflector face of the deflector assembly.

14. The water flow deflection device of claim 13, wherein the extendible deflector overlays at least a portion of the base deflector and is capable of being slidably adjusted relative to the base deflector between a retracted position, fully extended position and one or more intermediate extended positions.

15. A water flow deflection device configured to be attached to a side of a watercraft for the enhancement of a watercraft wake, the water flow deflection device comprising:

an elongated base with a first leading end and a second trailing end, the elongated base configured to be aligned along the side of the watercraft when the water flow deflection device is attached to the watercraft, and the elongated base having a deflector interface;

a deflector assembly comprising a deflector face and a base interface, the base interface operably engaging the deflector interface of the elongated base, the deflector face spanning between a leading end and an opposing trailing end, the leading end extending in an outward angled direction away from the elongated base such that the leading end is closer to the first leading end of the elongated base than the opposing trailing end of the deflector face and the leading end being in closer proximity to the watercraft than the opposing trailing end during operational use on the watercraft; and

two or more suction cup assemblies attached to the elongated base, a first suction cup being attached to the elongated base proximately located between the first leading end and the deflector interface, a second suction cup being attached to the elongated base proximately located between the second trailing end and the deflector interface, and the first and second suction cups configured to provide removable attachment of the elongated base to the watercraft;

wherein the deflector interface and the base interface are configured to allow a rotational adjustment of the deflector face relative to the elongated base.

16. The water flow deflection device of claim 15, wherein the rotational adjustment of the deflector face relative to the elongated base is between about 0° to about 30° in at least one direction.

17. The water flow deflection device of claim 15, wherein the rotational adjustment of the deflector face relative to the elongated base is between about 0° to about 30° in either direction, such that the rotational adjustment of the deflector face relative to the elongated base provides a total range of rotational motion of up to about 60°.

18. The water flow deflection device of claim 15, wherein the rotational adjustment of the deflector face relative to the elongated base is between about 0° to about 22.50° in at least one direction.

19. The water flow deflection device of claim 15, wherein the rotational adjustment of the deflector face relative to the elongated base is between about 0° to about 22.50° in either direction, such that the rotational adjustment of the deflector face relative to the elongated base provides a total range of rotational motion of up to about 45°.

20. The water flow deflection device of claim 15, wherein the deflector interface comprises a first concentrically-shaped configuration and the base interface comprises a second concentrically-shaped configuration.

21. The water flow deflection device of claim 20, wherein the deflector interface further comprises a first plurality of concentrically arranged teeth and the base interface further comprises a second plurality of concentrically arranged teeth, and wherein the first plurality of concentrically arranged teeth of the deflector interface and the second plurality of concentrically arranged teeth of the base interface are configured to operably interlock with each other.

22. The water flow deflective device of claim 15, further comprising one or more rotational alignment guidance indicia proximately located the base interface or the deflector interface.

23. The water flow deflection device of claim 22, further comprising an interface lock that is capable of operably locking the deflector interface and base interface at a desired rotational position of the deflector face relative to the elongated base.

24. The water flow deflection device of claim 15, wherein the deflector face has a textured surface.

25. The water flow deflection device of claim 24, wherein the textured surface of the deflector face comprises a plurality of concave indentations.

26. The water flow deflection device of claim 15, wherein the deflector assembly comprises a base deflector operably attached to an extendible deflector that is capable of slidably adjusting the surface area of the deflector face of the deflector assembly.

27. The water flow deflection device of claim 26, wherein the extendible deflector overlays at least a portion of the base deflector and is capable of being slidably adjusted relative to the base deflector between a retracted position, fully extended position and one or more intermediate extended positions.

28. The water flow deflection device of claim 15, further comprising an interface lock that is capable of operably locking the first concentrically-shaped configuration of the deflector interface and the second concentrically-shaped configuration of the base interface at a desired rotational position of the deflector face relative to the elongated base.

29. A water flow deflection device configured to be attached to a side of a watercraft for the enhancement of a watercraft wake, the water flow deflection device comprising:

an elongated configured to be aligned along the side of the watercraft when the water flow deflection device is attached to the watercraft, wherein the elongated base having a deflector interface;

a deflector assembly comprising a deflector and a base interface, the deflector having a deflector face spanning between a leading end and an opposing trailing end, and the base interface operably engaging the deflector interface of the elongated base; and

two or more suction cup assemblies attached to the elongated base, a first suction cup being attached to the elongated base proximately located a first leading end of the elongated base, and a second suction cup being attached to the elongated base proximately located a

second trailing end of the elongated base, wherein the first and second suction cups configured to provide removable attachment of the elongated base to the watercraft;

wherein the deflector interface and the base interface are configured to allow a rotational adjustment of the deflector face relative to the elongated base.

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